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What Static Sparks Cost Us

Science Teaches Motorists How to Protect Themselves Against a Danger in Fuel that Is More Deadly than Dynamite

By Raymond J. Brown

THROUGH the deaths of three motorists, all occurring within a week recently in widely separated parts of the country, attention of automotive engineers has been focused upon an odd but deadly peril in the gasoline tanks of automobiles. It is the danger of explosion and fire from the ignition of gasoline fumes by static electricity.

The tremendous scope of this newly discovered danger is apparent when we realize that more than 11,500,000 automobiles in daily use in the United States consume annually almost 3,500,000,000 gallons of gasoline—a fluid more dangerous than dynamite if not carefully handled.

Many Fires

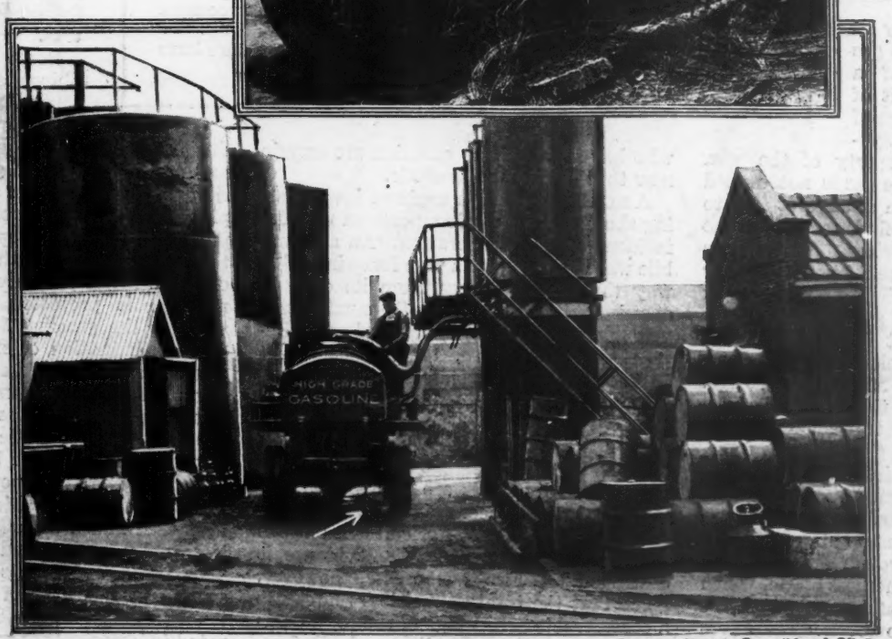
Organizations concerned directly or indirectly with fire perils suddenly have discovered that many disastrous fires, the origin of which was shrouded in mystery, actually were caused by static sparks coming in contact with the fumes of gasoline. As a result they are hastening to perfect preventive measures that will lessen this real source of property damage and death.

The American Petroleum Institute has forwarded a comprehensive questionnaire on the subject to oil producers and dealers in an effort to standardize scientific methods of protecting gasoline tanks and tank wagons from the hazards of static. The National Board of Fire Underwriters has issued a bulletin explaining in detail the fire danger that always accompanies gasoline.

The American Society of Electrical Engineers and the United States Bureau of Standards have been designated by the American Engineering Standards Committee as a joint committee to formulate codes for the protection of gasoline against lightning, and of course, static, which is potential lightning in miniature. The gravity of the problem is revealed by such activities as these.

Courtesy National Board of Fire Underwriters

These photographs show how a huge gasoline tank truck was demolished by an explosion due to static electricity at a wayside service station in Downey, Calif. The steel tank at the right was blown 48 feet



Courtesy Sinclair Consolidated Oil Co.

Protecting a tank truck from static sparks. Arrow points to dragging chain attached to chassis. This serves as a ground connection to carry off static electricity generated by friction of gasoline flowing through filling hose

What Is Static?

Static electricity may be generated in an infinite number of ways. Wherever there is friction it is likely to be produced. It is static that crackles in your hair when you apply a rubber comb in the wintertime. It is static that causes sparks to jump from your fingers when you touch a metal object or the hand of another person after walking across a carpeted floor. Usually these sparks will do no harm; but, if generated where gasoline vapor has combined with the air in explosive proportion—above the gas tank of

your car, or in any garage, service station, filling station, dry-cleaning establishment; in fact, anywhere where gasoline is used—static sparks may cause disastrous fires and explosions.

How easily and peculiarly static electricity may be generated with dangerous effect is shown by an incident last winter in a city of the Middle West. A physician, roused from his bed by an urgent night call, donned a fur-lined overcoat and rubber boots. He walked to his garage, and as he started to enter his automobile, there was a blinding flash, and an explosion. The machine burst into flames. The automobile was destroyed and the physician badly burned.

Static electricity, generated by the rubbing of the fur of the coat against the rubber boots, was the cause of the fire. The rubber soles insulated the doctor from the ground, as he walked, causing the electricity to be stored up in his body as in a condenser. Then, when his hand approached the metal body of the machine, the charge was discharged in a spark that ignited the gasoline fumes rising from the tank of the car.

Why Gasoline Explodes

Liquid gasoline is not dangerous in itself. Confined in a tank or can, it is quite harmless. But the gas it gives off, combined in proper proportion with air, is highly explosive. Scientists have determined that the ignited vapor from a single gallon of gasoline can do as much damage as 83 pounds of dynamite. In fact, it is this very explosive force of air and gasoline that makes possible the powerful automobile engine.

A slight spark only is necessary to ignite this gas—the glowing end of a cigarette, a burning bit of match, a weak discharge of static. The peril is magnified by a physical property of the gas. Because it is heavy, the gas is not carried away by the circulation of air, but falls to the lowest level it can find, settling to the floor and filling all crevices. It sinks into garage repair pits, where it may remain for days unless an extraordinary current of air carries it away.

Gasoline fumes that had settled in a repair pit caused a violent explosion in a garage in the Middle West a few weeks ago. A mechanic, entering the pit to drain a crankcase, was unable to budge the plug with his pliers. As he exerted more force, the pliers slipped, striking a bolt head and causing a spark. Immediately the fumes in the pit exploded, burning the workman severely and badly damaging the car.

Gasoline rushing through the hose at a wayside filling tank generates static, which passes through the metal nozzle into the metal parts of the automobile. There it is stored up because the car is insulated from the ground by its rubber tires. Touching the car with any conductor of electricity will cause the static to be discharged. The hand of the attendant at the filling station, or the hose nozzle as it is withdrawn from the tank may supply such a conductor. The resultant static spark, occurring over an open gas tank and near a spot where a greater or less quantity of gasoline is spilled every day, is bound to be dangerous.

Many automobile fires and explosions have occurred under these circumstances. Formerly fires occurring when the gas supply of cars was being replenished were attributed to backfire from the motors, or some other mysterious cause, but those who have studied the question are certain now that the cause was static.

A noted automotive engineer investigating the danger of static reports an unusual incident of static generation. An automobile was backed up to a wire fence in such a way that the discharge from its exhaust struck against the wires. So much static was generated by the discharged gases impinging on the wire, that persons who touched the fence felt distinct shocks.

Static Responsible for Many Fires

Statistics of the damage done by gasoline fires caused by static are unavailable, because, as one engineer stated in a report to the Department of Agriculture on the question, "in most cases the evidence is destroyed." Fire authorities, however, agree that the total annual loss represents a considerable percentage of the total damage resulting from gasoline and oil fires. This damage, according to the latest reports of the National Board of Fire Underwriters, amounted to $9,420,343 in 1921.

In Downey, Calif., static electricity, generated by gasoline flowing through a hose, recently caused a fire and explosion that killed eight persons. A 1700-gallon tank truck, filling the tanks at a service station, suddenly exploded. The tank was ripped from the chassis and hurled 48 feet through the air. Persons standing within 50 feet were enveloped in flames and their clothing burned from their bodies. Other persons 200 feet away were scorched and blistered and some of them thrown to the ground. All vegetation near the explosion was scorched.

The service station was demolished, and a frame bungalow that stood about 40 feet away was burned to the ground. Sunken concrete construction prevented the explosion of the five underground tanks in which gasoline was stored at the station, although the fluid was forced from four of the tanks through the vent pipes by internal pressure resulting from the external heat.

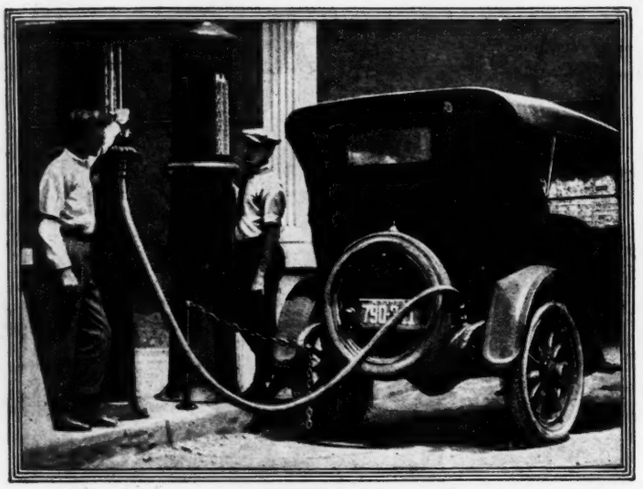
From a similar cause a garage in Marshfield, Wis., caught fire recently and automobiles valued at $50,000 were destroyed.

Some Safeguards

For some time gasoline dealers have been using a simple but effective method of preventing fires of this sort. A chain is attached to the chassis of the gasoline tank truck and permitted to trail on the pavement. This supplies a ground connection for the truck and causes any static generated to flow harmlessly to the earth. The truck destroyed in the Downey explosion just mentioned was supplied with a ground chain, but faulty adjustment is believed to have been responsible for its failure to perform its function.

Some owners of gasoline filling stations recently have carried the ground chain idea further, supplying a device which is used to ground every automobile that stops for gas. This consists simply of a metal chain attached to an iron pipe driven into the ground near the filling pump. When a car stops beside the pump, the attendant places the end of the chain on some metal part of the car. Thus the machine is protected should static develop as the gasoline flows into the tank.

The elimination of static by grounding also is being practised on a smaller scale in dry cleaning establishments. Many fires occurring in these places have resulted from the generation of static by the rubbing of silk garments that are being cleaned. Experienced operators now dip their hands into the gasoline in which the garments are immersed and draw off the static charges, if any, by a grounded metal finger ring. This practice prevents the creation of a spark at the surface of the gasoline where it might cause a fire. Since static is generated in dry weather more readily than in damp weather, much of the danger in cleaning establishments is eliminated by discharging steam into the workroom.



A filling station safeguard. Here a ground chain, attached to a metal post, is thrown over a metal part of the car

Where Peril Lurks in a Tiny Spark

FIRE and explosion losses traceable to gasoline and oil, mounted in the United States from $6,471,119 in 1918 to $9,420,343 in 1921—an increase of nearly $3,000,000 in three years. Experts now agree that a large percentage of these losses can be traced directly to the sparks of static electricity.

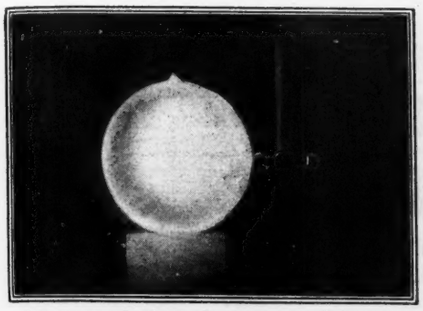
Like its big brother, lightning, static hurls its sparks at unexpected times and places. For that reason no specific rules can be offered as a sure safeguard against its dangers. Yet the average person, especially the automobile owner, will do well to observe a few general precautions: Don't allow uncovered gasoline to stand where sparks—from static or from other causes—may ignite the fumes and cause a disastrous explosion.

Guard against spilling gasoline on the floor of your garage or in your home. The gas it gives off is a potential destructive force more powerful than dynamite. A tiny spark is enough to set it off.

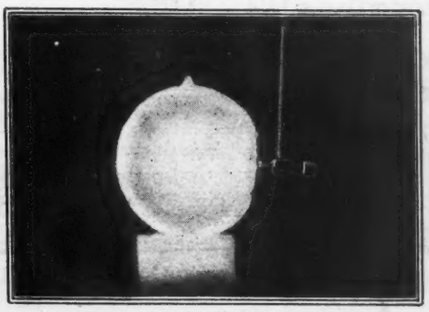
Carefully ventilate any inclosed place where gasoline fumes have been allowed to escape.

High-Speed Movies—5000 a Second

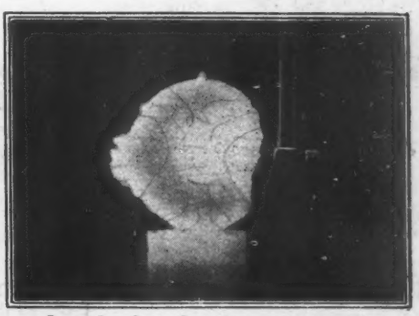
Marvelous New Camera Watches a Hammer Smash a Vacuum Bulb



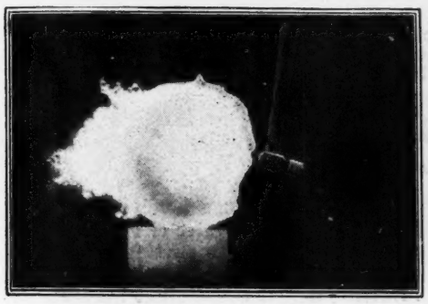
Photographed at the instant of impact



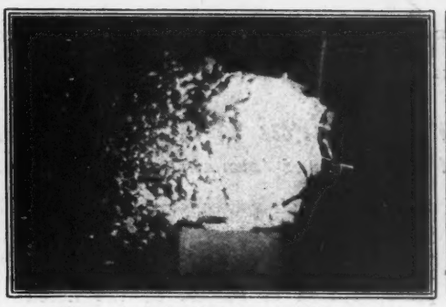
Appearance after 8/2500 of a second



Inrush of air breaks opposite side



The impact side still little altered



The whole bulb is crumbling now

1/100 of a second after impact

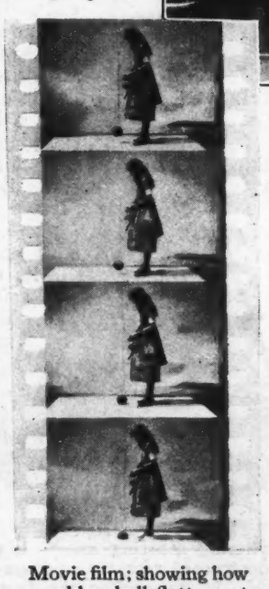
SIMULTANEOUSLY from the United States and England has come announcement of the invention of two revolutionary types of "slow motion" moving-picture cameras, capable respectively of making 3200 and 5000 exposures a second.

This permits the photographing in elaborate detail of actions the unaided eye cannot discern.

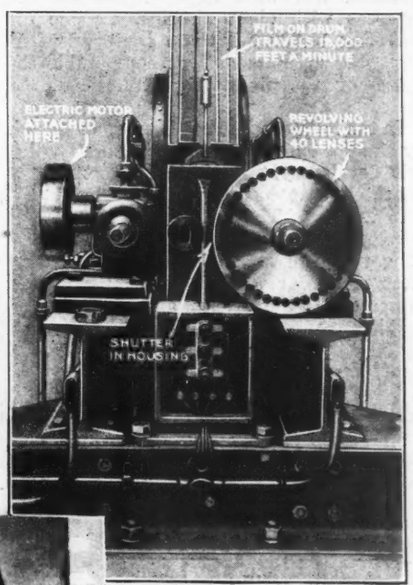
The bursting of a shell against armor plate, for example, which occupies less than one fiftieth of a second, by these wonderful cameras can be photographed in 100 pictures, which at normal projecting speed would be run off on a screen in between six and seven seconds. This enables scientific study to be made of each stage of a process that the fastest cameras hitherto devised have pictured as instantaneous.

Under the eye of the super-high-speed camera a rubber ball dropped to the ground is shown to be flattened almost into a hemisphere at the moment of impact, a circumstance which, by showing resiliency in detail, is of scientific value to tire manufacturers in deciding on the design and construction of their products. Other secrets of rapid mechanical action that the cameras will disclose are expected to lead to industrial and scientific improvements.

The American machine was developed by C. Francis Jenkins, of Washington, D. C. The British camera is known as the Heape-Gryll rapid cinema machine. They are large contrivances (weight of the English machine is four tons) operated by electric motors.



Movie film; showing how a rubber ball flattens at instant of impact


FILM ON DRUM TRAVELS 18,000 FEET A MINUTE
ELECTRIC MOTOR ATTACHED HERE
REVOLVING WHEEL WITH 40 LENSES
SHUTTER IN HOUSING

This British high-speed movie camera photographs "instantaneous" movements, making 5000 exposures a second. A section of this camera film is shown at left

The two machines are quite dissimilar in operation.

In the Heape and Gryll camera, rolls of film are wound about each rim of a drum 68 inches in diameter. Before each film and at right angles to the turn of the drum, revolves a wheel containing 40 lenses, geared and sized to produce pictures three quarters of an inch deep, the standard size of motion-picture "frames" or images. Between the lens wheels and the film is the shutter, the entire mechanism being operated by the one motor. Single exposures, when the machine is operating at maximum speed, are never slower than 1/100,000 of a second.

Giant searchlights and chemical flashes are employed to furnish light. In photographing such things as the explosion of a shell, the shell itself severs a wire in flight. This causes the camera to start at the precise moment of explosion, as the human hand is too slow to operate the switch.

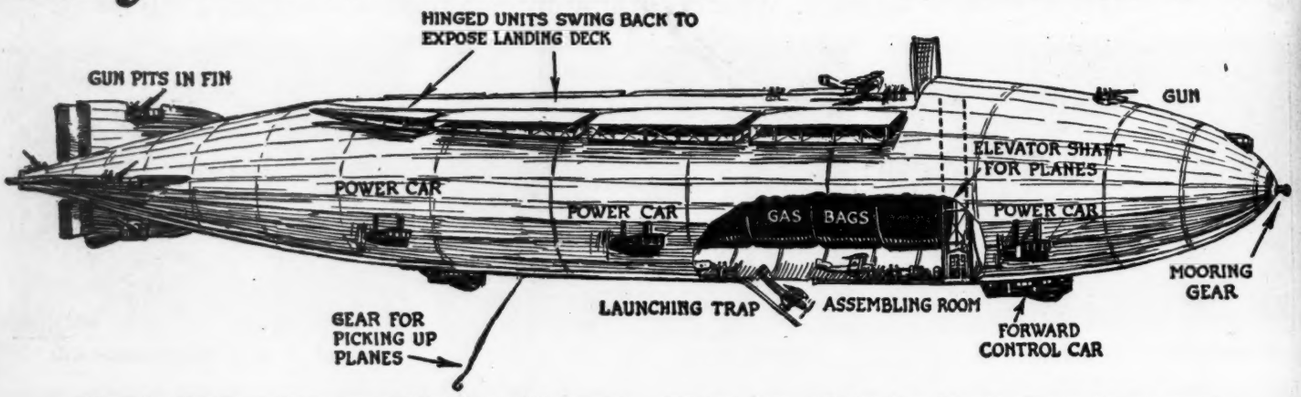
The Jenkins machine is smaller and simpler. It has a stationary lens and no shutter, and the movement of the film is continuous. Mr. Jenkins obviates a shutter and the necessity of halting the film each time it is exposed, by causing the beam of light that carries the projected image of the object being photographed to be bent progressively by a prism in the direction of the movement of the film. In short, the beam of light moves with the film and at precisely the same speed, flashing back to a new section of film each time an exposure is made.

The Scientific Detective

SCIENCE is making capture and punishment of the criminal so certain that eventually deliberate crime will disappear from the earth.

Such is the amazing prediction of Richard E. Enright, Police Commissioner of New York City. In a fascinating article written especially for the November POPULAR SCIENCE MONTHLY, Mr. Enright will tell how discoveries and inventions have made the modern detective a real scientist, eclipsing the exploits of *Sherlock Holmes* and other detective heroes of fiction.

Sky Leviathans of Tomorrow



Above is a diagrammatic representation of a possible monster plane-carrying airship of the future. In the accompanying article Rear-Admiral Moffett predicts airships more than 900 feet long. Notice how hinged cover units are swung back to expose a spacious landing deck for airplanes. Alighting, the planes would be lowered into the body of the ship

By Rear-Admiral William A. Moffett

Chief of the Bureau of Aeronautics, United States Navy

SHIPS of the sea have built empires, altered the destinies of nations, and exerted a profound influence on history through uncounted centuries. With the dawn of the twentieth century, ships of the air have come as a new challenger of time and space, and their influence upon the trend of world events is today one of the most potent factors in world progress and development.

Yesterday we crossed an ocean, today a continent; tomorrow we circle the globe. New routes for commerce open up by way of the polar air routes. London and Tokio are drawn together as by magic, and man, creeping on the earth, looks to the sky and reads there the story of a new era.

It requires no great tax on the imagination to picture some of the developments of air transportation which we may expect to see even in our brief span.

Larger Dirigibles to Be Built

The Navy has built at Lakehurst, N. J., the first rigid airship ever constructed in the United States — the ZR-1. It has been called a giant ship of the air—over 2,000,000 cubic feet of gas will be required to inflate it. It is as large as ocean-going steamers. It can carry a useful load of 35,000 pounds, exclusive of crew and supplies, and withal is mediocre in size and inferior in performance to similar ships that may be expected to follow.

Consider a ship of 5,000,000 cubic feet. Such ships now are being planned abroad. They would equal the size of the *Leviathan*, with a length of 900 feet and more and a diameter greater than the beam of that great vessel. They will carry a weight in fuel and other useful loading of more than 60 tons and could cruise halfway around the earth without a stop. Airplanes could be carried on them as are lifeboats on ocean-going vessels. These planes could land on a deck on top of the airship and be launched from it, carrying passengers for wayside destinations. They could be designed to carry a regiment of troops, and a fleet of them could transport an army to the ends of the earth, in time that could be reckoned in hours.

Imagination—but not too much of it.

Airplanes already have been carried by airships, launched from them, picked up by them. Polar air routes for short cuts by air commerce are considered the most logical development of dependable aeronautics. This assertion we have from such practical men of science as the noted explorer, Vilhjalmur Stefansson. And England will weld together her empire overseas with giant airships, capable of traveling 10,000 miles and equipped with passenger accommodations comparable to those of the finest transatlantic steamships.

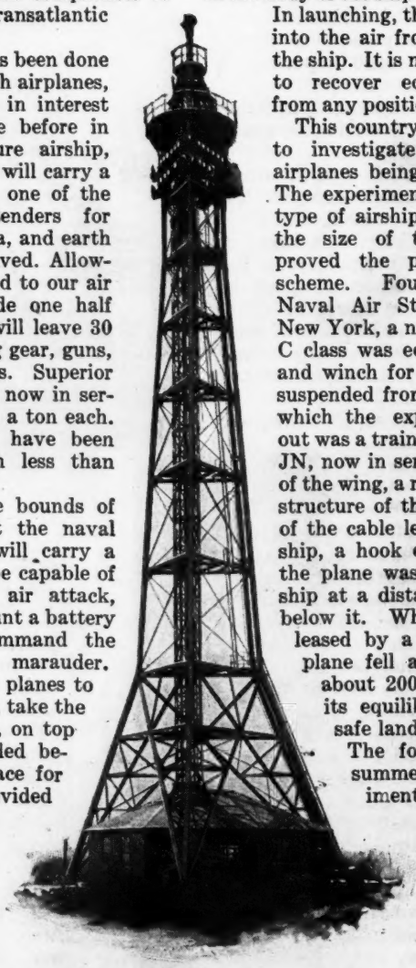
In the light of what has been done by airships operating with airplanes, this development rivals in interest anything that has gone before in aeronautics. The future airship, developed for naval use, will carry a sting that will make it one of the most formidable contenders for supremacy of the air, sea, and earth that has ever been conceived. Allowing 60 tons of useful load to our air giant, we may set aside one half of this for fuel, which will leave 30 tons for planes, landing gear, guns, ammunition, and bombs. Superior types of fighting planes now in service use weigh less than a ton each. Other types of planes have been developed which weigh less than 1000 pounds.

It is well within the bounds of reason to predict that the naval airship of the future will carry a dozen planes that will be capable of defending her against air attack, and in addition will mount a battery of guns that will command the respect of any enemy marauder. Means of returning the planes to the parent airship could take the form of a landing deck, on top of the ship or suspended beneath it. Stowage space for the fighters could be provided in the body of the ship along the keel line. The launching of them is merely a matter of pushing the planes off into space, where they can recover themselves with the ease of a bird thrown into the air.

One of the problems involved is that of keeping the ship's center of gravity below the center line of the envelope. Any extensive structure on the top of the airship involving weight would affect the stability and performance adversely. To offset this obvious difficulty, planes once landed could be quickly disassembled and the fuselage and wings quickly passed through a well in the body of the ship to the stowage space. In launching, they would be dropped into the air from the under side of the ship. It is no trick among airmen to recover equilibrium in flight from any position.

This country was among the first to investigate the possibility of airplanes being carried by airships. The experiment, conducted with a type of airship less than one tenth the size of those now building, proved the practicability of the scheme. Four years ago at the Naval Air Station in Rockaway, New York, a non-rigid airship of the C class was equipped with a cable and winch for carrying an airplane suspended from it. The plane with which the experiment was carried out was a training type known as the JN, now in service use. On the top of the wing, a ring was secured to the structure of the plane. On the end of the cable let down from the airship, a hook engaged the ring and the plane was suspended from the ship at a distance of about 50 feet below it. When the hook was released by a tripping device, the plane fell a vertical distance of about 200 feet, then recovered its equilibrium and flew to a safe landing.

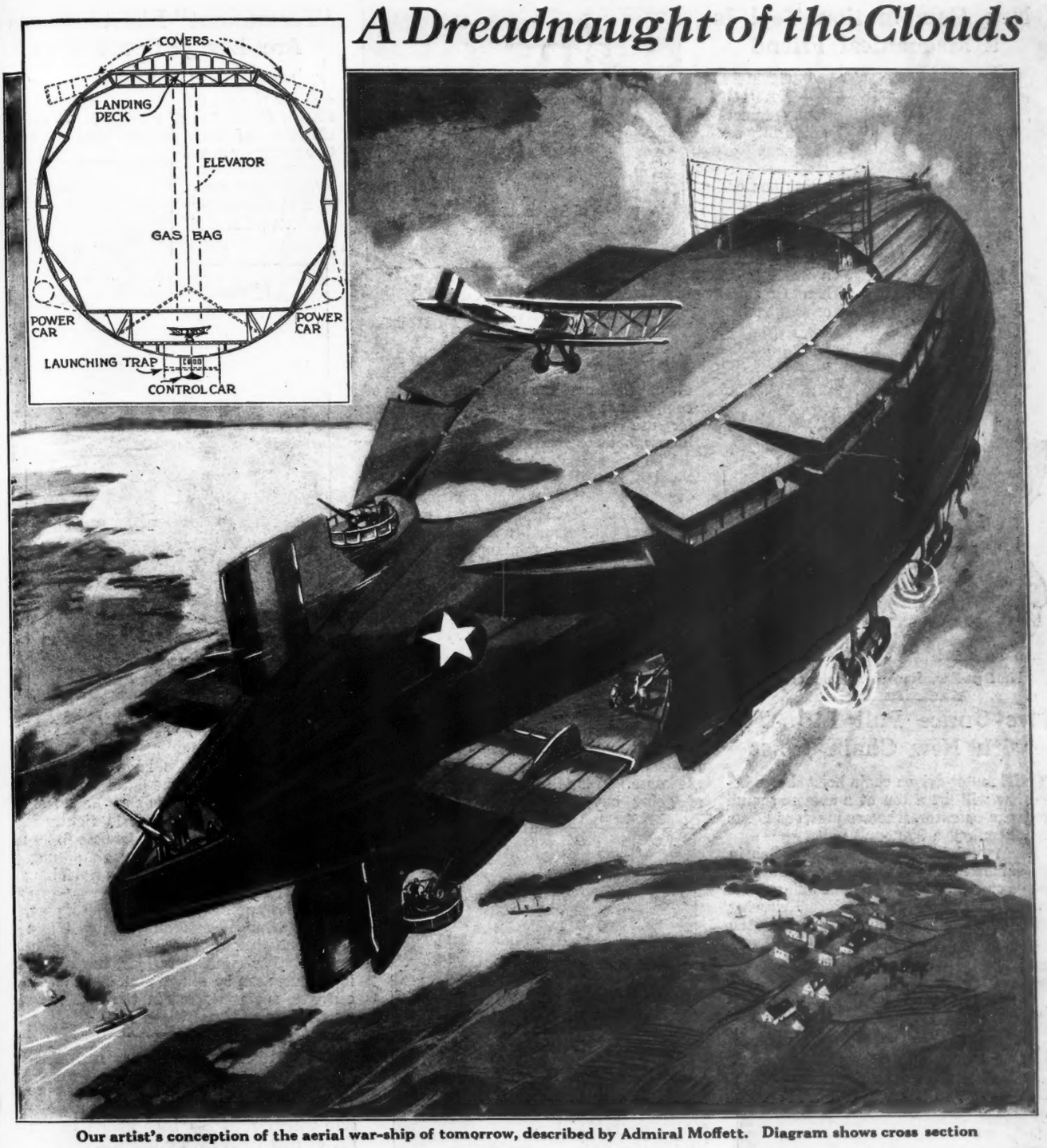
The following year, in the summer of 1920, these experiments were carried further by the British. The R-33, a sister ship of the one that made a round trip from England to the United States in 1919, carried out experiments in releasing, carrying, and picking up an airplane by means of a



This towering mooring mast, has been constructed recently at Lakehurst, N. J., to anchor the first American-made dirigible the ZR-1

New Combination Tool Is

A Dreadnaught of the Clouds



Our artist's conception of the aerial war-ship of tomorrow, described by Admiral Moffett. Diagram shows cross section

cable let down from the airship. These tests were similar to those carried on at Rockaway the previous summer, but were more extensive.

The plane, a Sopwith Camel, was fitted with a bridle terminating in a ring that extended above the top wing of the plane two or three feet. When the airship picked up the plane, the speeds of the two were approximately the same and it was a simple matter to engage the ring on the plane with the hook at the end of the cable. The plane was released by tripping the hook and the pilot dived, started his motor and flew away.

Until now one hazard in airship operation always has stalked like a specter at the heels of this development. Hydrogen-inflated ships carry with them the ever-present danger of fire. Many aerial disasters have been traceable to this.

The United States, possessing as it does the only extensive helium supply in the world, is particularly favored by nature. Helium, an inert gas, is not inflammable. It has but little less than the buoyancy of hydrogen and can be produced at a cost which, though higher than that of hydrogen, is inconsequential compared with the safety and dependability gained.

We Must Conserve Helium Supply

However, we cannot afford to be as prodigal with this gift of nature as we have been with others. A well considered program of conservation of this valuable product is essential to our national welfare, from a commercial standpoint as well as from that of national defense.

The helium airship will make this form of travel safe to a degree never before possible. It will insure low insurance rates on merchandise carried by airships.

From a military point of view, helium has placed a new complexion on the airship-airplane controversy. The airship filled with helium and defended by guns and airplanes, will be in effect a battleship with the sky as a limit. As the battleship is subdivided into watertight compartments, so the airship is made up of a number of gas cells. When a watertight compartment is punctured, the ship does not sink. This method of construction has saved ships even against the destructive effect of torpedo explosion. So the puncturing of a gas cell in the airship will not spell disaster. We may see these battleships of the air, riddled with shells, still fighting gallantly on to victory.

As a basis for the future of airship development in this country, the Navy, in constructing the ZR-1, is building wisely and well. America should be in a position to point the way to the world.

New Combination Tool Is a Mechanical Friend

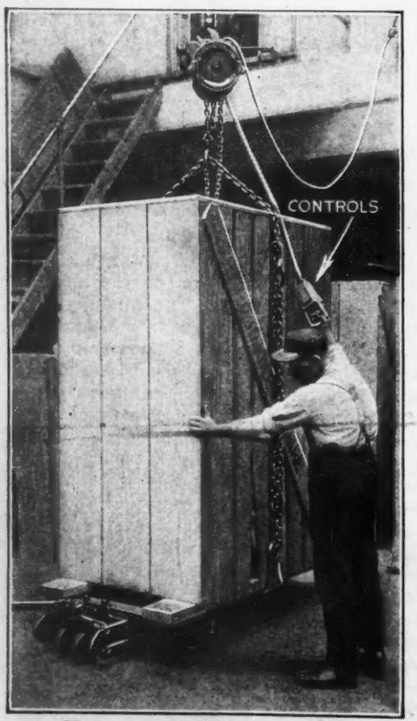
A COMBINATION tool, of remarkable utility, consists simply of a steel bar hooked at one end, with a small hammer-head projection. It serves either as a nail puller, hammer, chisel, or crowbar.

Nail puller, hammer, and crowbar

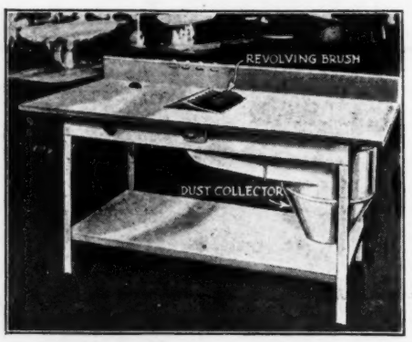
Five-Ounce Pull Lifts Ton with New Chain Hoist

THE motor-driven chain hoist shown below will lift a ton at a five-ounce pull from the operator, whereas previous hoists have required a 90-pound pull.

The motor is controlled by a switch in the handle held by the operator. Turning on the current lifts the load. Pulling down on the handle winds the chain. Releasing the handle causes the load to stop, while the motor continues running.



How one man lifts a ton load



Inexpensive Dry Cleaning with Diminutive Plant

A MACHINE that makes possible a dry cleaning service without the expense of skilled labor and the employment of complicated machinery has been designed for use by tailoring shops, dry-goods houses, hotels, and cleaning shops.

The large brush shown in the center of the table revolves rapidly, loosening the dust from the fabric, while a strong draft draws the dust into a centrifugal type dust collector. The smaller brush is used for "spotting." The four plungers at the left end of the dash operate fluid containers. The dust collector is shown below the table.

Time Saved, Colds Avoided by This Built-In Mailbox

AN INGENIOUS accessory for the home is a newly invented, built-in mailbox. The box is so arranged that a letter, dropped into the slot on the outside, can be removed through a small door within the house. This will eliminate the necessity of going out of doors when the postman leaves the mail, averting the possibility of contracting colds in inclement weather. Moreover, mail can be collected when one has risen late and is not dressed for the street.

Old and new types of mailbox

How Campers May Purify Unsafe Drinking Water

CAMPERS in districts where streams may be polluted will be relieved to learn that the Army Medical School at Washington, D. C., has evolved a handy method of purifying suspected water.

One or two drops of tincture of iodine will vanquish all the germs in a quart of unsafe water within from 20 to 30 minutes, according to this authority. Just shake the water container well. The greatly diluted iodine cannot be tasted.

"Permanent" Light Fixtures Are Easily Detachable

A NEW type of wall and ceiling socket for electric fixtures facilitates the removal, for cleaning, replacing, or interchanging, of those fixtures that we now term "permanent."

The socket consists of two parts, one fastened firmly to the wall or ceiling and the other to the fixture. The plugs have large binding screws with which the fixture wires are connected. The fixture is suspended from a hook in the plug and is held tightly in place by a spring catch. Before the fixture can be removed, this catch must be sprung. This feature prevents the accidental falling of a bowl or wall light.

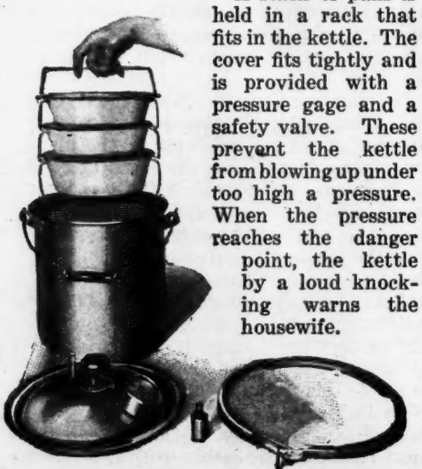
In homes equipped with this type of plug, lighting arrangements can be changed in a short time without the services of an electrician. For special occasions, extra lighting fixtures can be rented and installed as easily as one can screw in the lead to an electric iron or toaster.

Adapted to two types of fixtures

Automatic Pressure Kettle

MADE of enameled steel, a new pressure kettle that seals itself when the pressure within rises has been added to the list of new labor-saving utensils.

A stack of pans is held in a rack that fits in the kettle. The cover fits tightly and is provided with a pressure gage and a safety valve. These prevent the kettle from blowing up under too high a pressure. When the pressure reaches the danger point, the kettle by a loud knocking warns the housewife.



The parts of the pressure kettle

INTERESTING PEOPLE and Their

Folding Camp Stove Burns Gasoline from Car

HOME cooking comforts are provided the camper or motor tourist by the folding camp stove shown above. It burns gasoline, permitting the use of fuel extracted from the tank of the motor car.

A windshield, warming shelf, detachable pressed steel legs, and a two-burner iron grate are features of the stove, which may be folded to 4½ by 10½ by 19 inches for carrying. The entire outfit, including fuel tank, weighs only a few pounds.

Tiny Microscope Magnifies Object 225 Times

A SMALL pocket microscope, only four inches long and weighing but 15 ounces, recently perfected, is capable of magnifying an object 225 times its actual size. The instrument consists of a cylindrical base and stand into which two other cylinders telescope. Beneath the lower lens is a hollow stage upon which the material to be inspected is placed. Light reflected from a concave mirror underneath, illuminates the material. When completely closed, the degree of magnification is 50 times.

The pocket microscope extended and collapsed

To increase this, it is necessary only to pull out either of the two cylinders to a point where a scale indicates the desired number. By pulling out both as far as they will go, an object is magnified 225 times. If the lower cylinder is removed, this is cut in half, thus giving a magnification of 25 times.

The instrument has been designed not only for use in laboratories, but as a field instrument for workers who find it necessary to observe minutely the condition of wood or metal with which they are working.

Rake-Mower Trims Edges of Lawn

PERSONS who mow their own lawns usually are compelled to use grass shears to supplement the work of their mowers in trimming the growth at the sides of buildings and fences or around trees or flower beds. Now a Michigan manufacturer has perfected an ingenious small mower, no larger than a rake, that will cut grass any place where a rake might be thrust.

The cutting is done by a set of eight sharp-edged cutting disks arranged along the front and operated by driving wheels at the rear. The driving wheels do not pass over the grass until it has been cut. The revolving disks will cut tall grass as well as short in a 16-inch swath.

Holding the handle in a natural position will cut the grass short enough for good appearance and the promotion of growth, yet will not permit the driving wheels or cutters to pick up twigs or small stones.

The new mower is silent in operation and is light in weight. The blades are removable for sharpening or for the substitution of new ones. The rake is especially adaptable for trimming steep terraces.

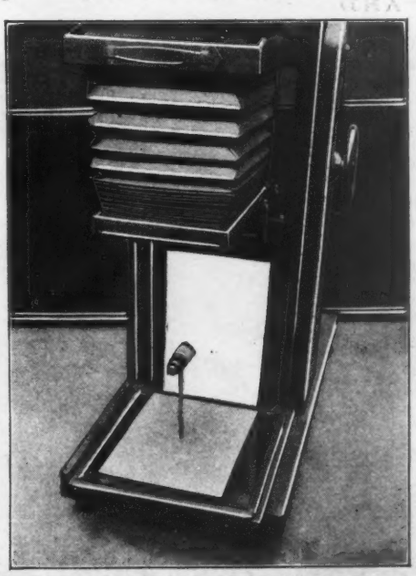
This easily operated lawn trimmer has a series of eight revolving cutting disks (shown in inset) that shear the grass

Supporting Small Objects before the Camera

GRAY backgrounds often are desirable in photographing small objects in the studio, but almost invariably the photographer resorts to the white background to obviate the many difficulties otherwise encountered. If the object is placed on a clear glass with the gray card underneath, he often gets reflections across the plate. If it is placed directly on the gray card, he gets disagreeable shadows and also an unpleasant mottled appearance, since each little corrugation in the cardboard stands out plainly in the photograph.

To avoid these difficulties there has been devised an invisible support method, as shown in the photograph. This is merely a nine-inch section of curtain rod, either soldered to a metal base or set firmly in a wooden one, which is pushed through the center of the cardboard desired for the background. A T-joint can be made to fit in the top end of the rod and this with the addition of a little modeling clay, will support any small object readily. If a long or heavy object is to be photographed, two such supports can be employed.

With this method there is no chance for reflections, and shadows are eliminated.



Photographing a small bottle on a gray background, using the invisible support

Wall Holder for Telephone Has Coin Box and Pad

THIS handy wall telephone holder, carries a little coin container to remind neighbors that telephone service costs money. A conveniently arranged pad may be used for notes or a ready reference directory of numbers.

The compact holder

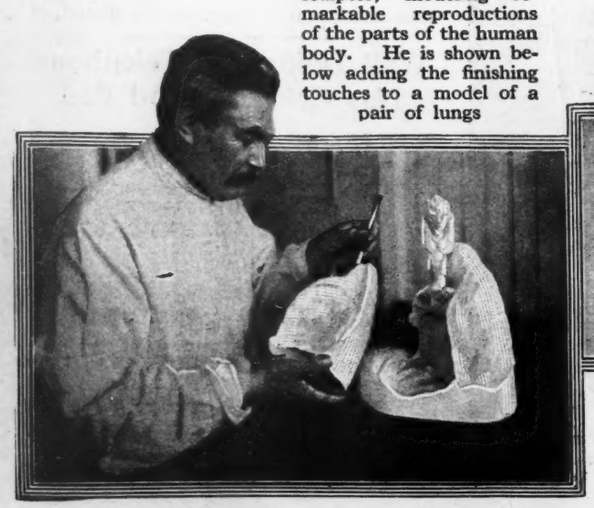
INTERESTING PEOPLE and Their Hobbies

PEANUT MANIKINS in lifelike poses are turned out by the dozen by George Berryman, manager of a Seattle, Wash., department store, after office hours. Each little form he makes from two peanuts, odd pieces of wire, glue, and paper

BUILDING SHIP MODELS is the hobby of Hobart Bosworth, famous actor of stage and screen, during his spare hours. One of his creations, a full rigged ship, complete in miniature detail, is shown above. He carries his handiwork and a set of tools about with him in a special trunk. Theatrical dressing rooms serve as his workshops

INDIAN HISTORY is being carved in elaborate figures on a huge cedar pole by Will Shelton, chief of the Snohomish tribe and head of the Tulalip Indian Reservation School in Washington. Already the chief has spent 3600 hours "writing" his tribe's history. When completed, the totem pole will stand 100 feet high

ANATOMY AND ART go hand in hand in the workshop of Gustave Van Bouchaute, a physician of Paris, France, who leaves his practice long enough to work as a sculptor, modeling remarkable reproductions of the parts of the human body. He is shown below adding the finishing touches to a model of a pair of lungs



A VIGOROUS ATHLETE AT 72, Prof. Gilbert Ellis Bailey, professor of geology at the University of Southern California, goes to the mat with the huskiest of his students. Wrestling, one of the most strenuous of sports, has kept him young, and in good health, he says

Oilwell Fire Snuffed like Candle

Ingenious Cap Smothers Fatal Texas Blaze

The Hughes-McKie oilwell fire near Corsicana, Tex., as seen from a distance. Thirteen men were killed and $60,000 in oil was consumed

C. T. Kinley (at left) and the suit used in recovering bodies of oil fire victims. The suit is made of several thicknesses of fireproof asbestos cloth

MODERN invention rarely has been put to a more dramatic use than it was a few weeks ago, when a devastating fire, which had killed 13 men and had consumed more than $20,000 worth of oil a day for three days, was extinguished by a giant candle snuffer devised for the emergency by an oilwell foreman.

This was the first time in the history of oilwell drilling that a burning oilwell was capped so successfully as to extinguish the fire.

The fire broke out at the Hughes-McKie well near Corsicana, Tex. So fierce were the flames, and so suddenly did they burst forth, that 13 workmen were burned to death before they could flee. For the next three days and nights more than 100 workmen, wearing special asbestos suits, labored unceasingly to recover the charred bones of their comrades and to extinguish the fire. Just when there seemed no hope of halting the fire before the entire capacity of the well should be consumed, D. L. Kelly, trouble shooter for the J. K. Hughes Company, appeared with the request that he be permitted to try his snuffer. For months he had been working on this invention, and had rushed it to completion after the Hughes-McKie fire started.

Kelly's invention is a huge cap supported by an iron tripod, from which it is swung on chains. Leading from the cap is a perpendicular pipe 10 inches in diameter and eight feet high, and a smaller lateral pipe forming a T-joint with the main pipe. In the lateral pipe, at this joint, is a gate valve. A second gate valve is located near the top of the main pipe.

The entire device was hauled by an endless tread tractor to the burning well, where the tripod was erected. With the assistance of eight men, Kelly swung the cap over the mouth of the well, dropped it into place and made it practically airtight by means of a casing of sheet metal. Then the gate valve high in the main pipe was closed slowly, completely shutting off oxygen from the oil and smothering the flames.

At the same moment the valve in the lateral pipe was opened, permitting unburned oil and gas under pressure to escape through this pipe, which emptied into a pit more than 100 feet away. Almost the instant the valve on the cap was closed the fire flickered out.

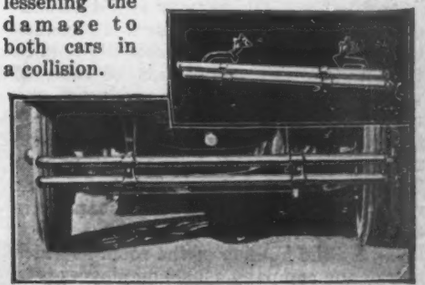
Repairs to the burned well are now under way, and it is expected its operation will be resumed shortly. Oil men of the Texas and other districts have shown much interest in Kelly's device since its successful demonstration. In fact, its inventor expects it will be added to the equipment of every oilfield as a protection against the greatest menace of the industry—fire.

Above: The well burning at its greatest intensity. This great column of flame and smoke finally was snuffed out by the ingenious capping mechanism, shown at the left, with its inventor, D. L. Kelly. Closing of the upper valve smothered the flames

Rubber Bumper Absorbs Jolts in Collision

THE chance of serious accident or disaster from bumping into any obstacle is said to have been lessened greatly by a new rubber bumper for automobiles recently put on the market. It is made of high-carbon steel tubing, coated with rubber of the kind used in the treads of tires, and it is attached to the automobile by strong U-shaped springs.

The hollow steel provides strength, while the rubber coating softens the impact, lessening the damage to both cars in a collision.



The rubber bumper, attached with springs

recalled to you travel on trains, distant
between that face and the face of some one
number, picture, theme, in rubber, plastic

The camera of the memory. Through our eyes we register indelible impressions which the mind files away

Are You Using All of Your Brains?

An Article on Memory—and How to Improve It

By James J. Walsh, M.D., Ph.D.

Professor of Physiological Psychology, Cathedral College, New York City

In remembering a flower, such as the new pure white amaryllis (at left), named for Mrs. Warren G. Harding, we associate the name with the senses of sight and smell, which fix it firmly in our minds

A FEW weeks ago the New York newspapers, in reporting a trial in which a noted criminal lawyer appeared as counsel for the defense, commented on the remarkable feats of memory which he performed many times during the closing days of the trial. Although he had made no notes at any time during the trial, he was able to repeat, word for word, just as they had been uttered by the witnesses, lengthy pieces of testimony that had been given days before.

What he repeated was not merely the gist of what had been said. It was the exact, verbatim testimony. His feat of memory won the case for the lawyer and saved his client from prison.

Amazing though this may seem to persons who have difficulty recalling names, addresses, and telephone numbers, actually it is no unique performance. Successful men almost invariably have retentive memories—storehouses of facts, assembled in order and properly indexed so that they may be found easily and put into use when needed.

Washington and Napoleon are said to have known thousands of men in their armies by name. Theodore Roosevelt has been credited with having remembered everything he ever read. Abraham Lincoln had at his fingers' ends every fact he ever learned. Pascal, the great scientist, could repeat the entire Bible. Shakespeare had a vocabulary of 15,000 words, Milton of some 10,000. Memory is nearly always an attribute of the great, for, as Bacon sums it up, "All knowledge is but remembrance."

And yet a good memory is not the exclusive possession of great men. Thousands of people in ordinary walks of life hold in their minds vast collections of facts of various sorts which they can produce at any time they wish. The telephone operator in the office of a large corporation will remember hundreds of telephone numbers. The clerk at the information desk in the office of a great public utility company in downtown New York City, can tell you instantly the number of the room in which any of the company's 3000 employees is to be found. A hotel manager in the Middle West can greet by name any one of the thousands of persons who have registered in the hotel since he has been in charge. An office boy on a Chicago newspaper knows virtually every street in the city by location and name, and has on the tip of his tongue a vast fund of other information about the city—the locations and numbers of fire alarm boxes, fire houses, and police stations, the street numbers of important buildings.

All of us cannot become Shakespeares, or Pascals, or Napoleons, but by systematic, intelligent exercise we can develop our memories so that they will be of real value to us in our contact with the world.

The training of the memory must be undertaken with the idea of aiding nature, not compelling her to alter her process of recalling past impressions to the mind. An example probably will aid me in explaining Nature's method of actuating the memory.

You see on your desk pad a brief note—possibly only a name, an address, or a single word. It recalls to you instantly a business engagement. The train of thought by which you connected the engagement with the entry on your pad, was started voluntarily. This voluntary action of the memory is called recollection.

You take a streetcar to keep the engagement. While riding on the car, you suddenly find yourself thinking of some event of your boyhood. The thought apparently has just "popped into your mind" from nowhere. This involuntary manifestation of memory is called remembrance.

Actually, there was no difference at all between these two mental processes. You may not have been aware of it, but something occurred while you were riding on that car to make you remember the incident that seemed to enter your mind from nowhere. A man sitting opposite you may have been wearing a suit of a peculiar shade of brown, which recalled a suit worn by some actor in the event which you thought you had forgotten. You may have heard a railroad whistle that

Eight Rules for Memory

HERE are eight simple rules which, Doctor Walsh says, should help you to train your memory:

1. Learn to concentrate.
2. Use as many senses as possible in obtaining impressions of an object.
3. Develop, by patient, systematic exercise, the faculties that seem to be weak.
4. Try to make your first impressions of an object permanent.
5. Revive your impressions frequently. After a vacation actors must rehearse rôles in which they have appeared many times.
6. Have confidence in your memory. Don't rely too much on pencilled notes or on the memories of others.
7. Establish as many associations as possible for your impressions. In attempting to remember a fact, satisfy yourself as to what it is, whence it comes, where, when, how, and why it was made, and whither it is going.
8. Make your memory training practical and useful. A telephone operator, for example, might use her time better in committing telephone numbers to memory than in memorizing English verse.

A child usually remembers a zebra as a striped horse and a giraffe as a horse with a long neck. This thinking in pictures and associating new impressions with old, is invaluable to memory in after life, says Doctor Walsh

recalled to you travel on trains, distant places, your boyhood home, the friends of your youth and at last the event that "popped into your mind." The train of thought occupied less than a second. You were not conscious of the intermediate steps, but they were there just the same.

You can see, then, how recollection and remembrance may be considered as the same process. This knowledge can aid us in increasing the powers of our memories.

Memory Never Relinquishes a Fact

Past events and impressions are stored up in what would seem to be various layers of our memory which, as recent observation demonstrates, never entirely relinquishes any fact that they receive. In other words, we never completely forget anything we have learned. Our problem, then, is to train our active mind to reproduce for us any desired fact at our will. That this can be accomplished has been proved conclusively many, many times. It is done through what is known as the law of association, which is the foundation of all systems of memory training. We must learn to associate facts that we know with the facts we are attempting to commit to memory, so that the recollection of one fact invariably will lead to the remembrance of the other.

Doggerel is useful in memory training, for rhyme and rhythm stick in the mind. Rhythm is especially applicable in remembering telephone numbers and names.

The first thing to be cultivated by a person who desires to improve his memory is the habit of attention. "Attention," Lowell says, "is the stuff that memory is made of, and genius is accumulated memory." Therefore, as a first step, learn to concentrate.

Perhaps you say you cannot remember faces, but if that is true, it is because you are not sufficiently interested in the new people you meet.

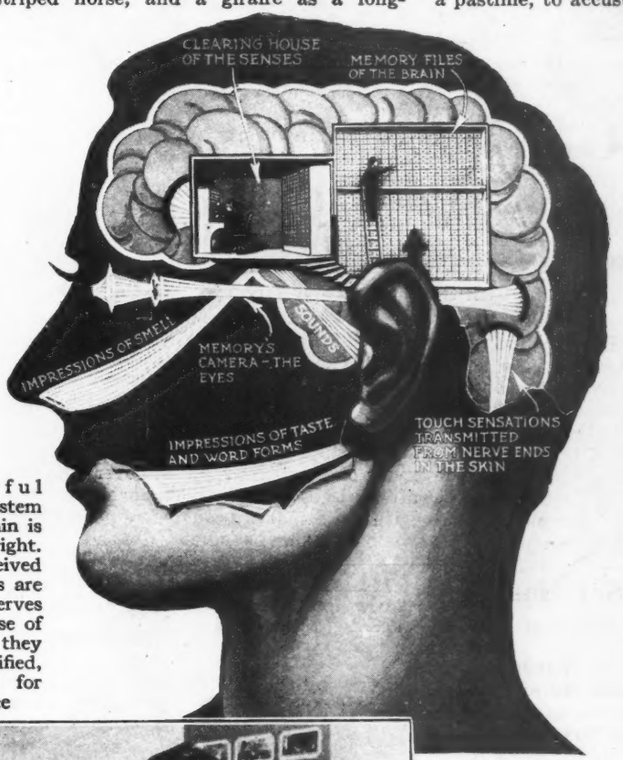
A Memory Feat

Henry Clay once called by name a man whom he had seen for a single day in a jury box 20 years before, despite the fact that an accident had disfigured the man's countenance in the interim. The man's profile had remained unchanged, and Clay had trained himself to remember faces through their dominating characteristics.

You can do much the same thing. Catalog in your mind the various types of faces—round, oval, long, bony,—and the various types of eyes, noses, chins, mouths, foreheads, and jaws; then fit each new face you see into its proper type and make mental note of the features in which it differs from other faces. Try to find some resemblance between that face and the face of some one you know well. Leonardo da Vinci drew sketches of all possible faces and numbered them. Possibly you cannot do that, but you can make mental sketches of the faces you see and classify them according to their types.

In seeking to remember facts, think in pictures. A child remembers a zebra as a striped horse, and a giraffe as a long-necked horse. Try to bring every possible faculty and sense to bear on the storing up of a fact in your memory. You can use your sight and hearing always, your taste, feeling, and smell frequently. If you want to remember a number, picture in your mind the numerals that make up that number—picture them in blue electric lights if that will make the picture more vivid. Then get the rhythm on the successive numerals fixed in your ears. The telephone number "Main eight six hundred" has just as definite a rhythm as the first line of the "Star Spangled Banner."

If remembering numbers is your chief difficulty, do simple sums in arithmetic as a pastime, to accustom yourself to dealing with numbers. An acquaintance of mine cured himself of the unfortunate habit of forgetting telephone numbers and addresses by a simple game with which he occupied himself when walking along the street.


CLEARING HOUSE OF THE SENSES
MEMORY FILES OF THE BRAIN
IMPRESSIONS OF SMELL
SOUNDS
MEMORY'S CAMERA—THE EYES
IMPRESSIONS OF TASTE AND WORD FORMS
TOUCH SENSATIONS TRANSMITTED FROM NERVE ENDS IN THE SKIN

The wonderful memory filing system of the human brain is illustrated at the right. Impressions received by the five senses are transmitted by nerves to a clearing house of the mind, where they are sorted, classified, and filed away for future reference

© Keystone

How a modern vocational bureau tests the memory by means of lettered cards and building blocks

An Exercise

He tried to commit to memory the numbers on the automobile license plates as the cars passed him. He varied this by trying to add up the numerals on each plate before the car was out of sight. A few months of that treatment cured him.

A similar cure may be practised by persons who find difficulty in remembering words. Learn a few lines of verse each day. When you are riding on street cars, commit to memory the text of the advertising cards.

If you cannot remember names, attempt a classification of them similar to your classification of faces. If the names are of foreign origin, remember from what country they come. Fix their rhythm in your mind. Associate them with names that are similar. Names derived from such things as colors and animals suggest their own classifications. Other names may suggest pictures. In any case, spell the name to yourself and see the letters in your mind.

Is Genius "Accumulated Memory"?

The only method of remembering music that I know consists of hearing the music repeated many times. Chorus numbers on the stage are drummed into the minds of the performers by frequent repetition. Trained musicians, of course, can learn music simply by reading notes, as you would learn poetry. Josef Hofmann, the famous pianist, once learned a difficult and lengthy concerto from the notes during a short railway journey. A few hours later he played it at a public performance for the first time in his life entirely from memory. Once when the orchestral score for the "Midsummer Night's Dream" overture had been mislaid before a concert in London, the great Mendelssohn prepared the entire score from memory!

Geniuses such as these developed remarkable memories not only through tireless training, but largely through reliance on their memories. Early in their careers they learned to use their brains—all of them.

Baby's Canvas Bathtub Lightens Work

UNUSUALLY useful for the modern mother is this combination canvas bathtub and dressing table for the baby. It is designed to fit within the ordinary bathtub, and is supported by the sides of the tub. Not only is it sanitary for the baby because of a continuous flow of clean water, but it provides comfort for both mother and child.

After the bath the hinged cover serves as dressing table

After the large bathtub has been filled, the baby's tub is fitted in place and is ready for use. The infant nestles comfortably in a soft canvas bag that conforms to its body, while the mother, seated on a stool beside the tub, administers the bath.

Openings at the corners of the small tub allow free flow of water in and out, thereby assuring cleanliness and uniform temperature. The entire outfit is extremely light and can be carried easily from place to place. It relieves the mother of tiresome bending and stooping and of carrying water for the bath.

The bathing bag dries almost instantly after water is removed from the bathtub. It is equipped with a hinged dressing table made of heavy canvas that covers the tub after the bath, and which, covered with a bath towel, makes a convenient place to lay the baby while he is being dressed.

Portable Radio Set Has no Aerial nor Ground

A PORTABLE radio set which, it is claimed, uses no ground and no aerial, is here shown. It is said to have picked up broadcasting stations 100 miles distant. A secret type of circuit using one amplifying tube, is the explanation given for the remarkable performance.

The photograph shows Miss Helen Conroy, of Brooklyn, N. Y., listening in during her lunch hour at City Hall Park.

Listening in with new portable receiving set, carried in a small case

Sheet-Music Pages Turned by Foot Pressure

ONE of the recent inventions is an automatic sheet-music turner, adapted to all sizes of pages. The sheets are engaged by clips of fine wire, and are turned when pressure is exerted on a pedal.

Pressure on pedal turns the pages

WHO are the world's ten greatest scientists?

From the whole field of science and from all the pages of history, which ten men stand out clearly above the thousands who have done great things, and why?

POPULAR SCIENCE MONTHLY put this question to the British scientist who has done perhaps more than any other one man in modern times to put the facts of science within the reach of the average man and woman—to J. Arthur Thomson, Regius Professor of Natural History in the University of Aberdeen and author of the tremendously popular work, "The Outline of Science."

In our next month's issue we will announce Professor Thomson's selections. He will tell in his own fascinating way why he has placed the names of these scientists in the list of the world's ten greatest.

Safety Platform Designed for Washing Windows

A NOVEL hanging platform that enables a person to wash the outside of upper-story windows in comfort and safety has been invented by James C. Brewster of Fort Madison, Ia. The device consists of a stand and cage formed of iron bars, with hooks or hangers that extend across the windowsill and engage the portion of the windowsill within the room.

Diagonal brace bars that are a part of the cage have downwardly curved ends that rest on the outer horizontal portion of the sill and function to hold the cage and stand level while it is occupied by the person washing the window.

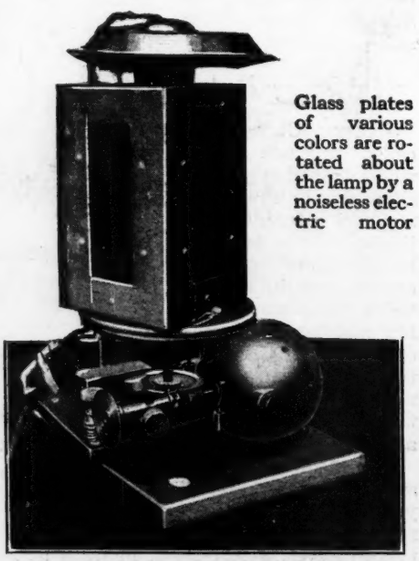
The hooks holding the cage to the windowsill are made in two sections, hinged together. This makes it easy to fasten the platform in place or to remove it when the work is completed.

The inventor declares the device is as safe as a kitchen floor.

Single Lamp Varies Colors on Advertising Signs

TO PRODUCE changes in color in the illumination of advertising signs, an Indianapolis inventor has devised the electric lantern shown here.

Hitherto, color changes in illuminated signs were effected by the employment of many electric lamps of various colors. With this lantern, the effect is produced by revolving glass plates of different colors. These plates are rotated about a single lamp by means of an electric motor that is noiseless and self-lubricating and that requires no further attention once it is installed.



Glass plates of various colors are rotated about the lamp by a noiseless electric motor

THE Editor will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in Popular Science Monthly.

World's First Aerial Bicycle Flies

AN AERIAL bicycle, called the "cycleplane," driven only by foot-power applied by the pilot to an arrangement of pedals, recently achieved a short flight near Dayton, Ohio. It is said to be the first man-propelled flying device ever to lift itself from the ground.

This remarkable invention, the achievement of W. F. Gerhardt, aeronautical engineer at McCook Field, Dayton, Ohio, is 20 feet high and has seven tiers of wings, yet weighs only 98 pounds. It is admittedly crude in construction, being hastily built. Paper was used largely to cover the framework. The fuselage is torpedo-shaped and about 12 feet long.

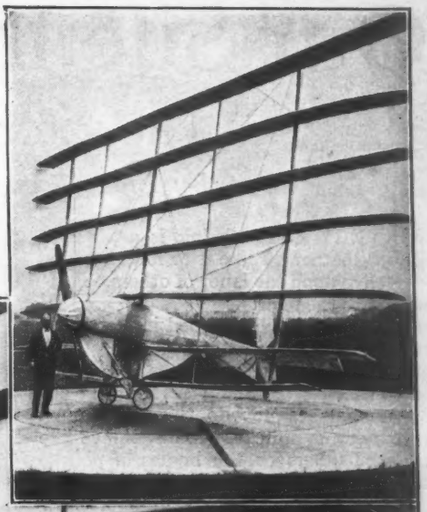
The pedals are connected with the propeller at the front by a shaft and gear arrangement. Complete control is centered in the "joystick," just in front of the pilot. It moves three ways, forward and backward to control the elevator and with a twisting movement to control the rudder.

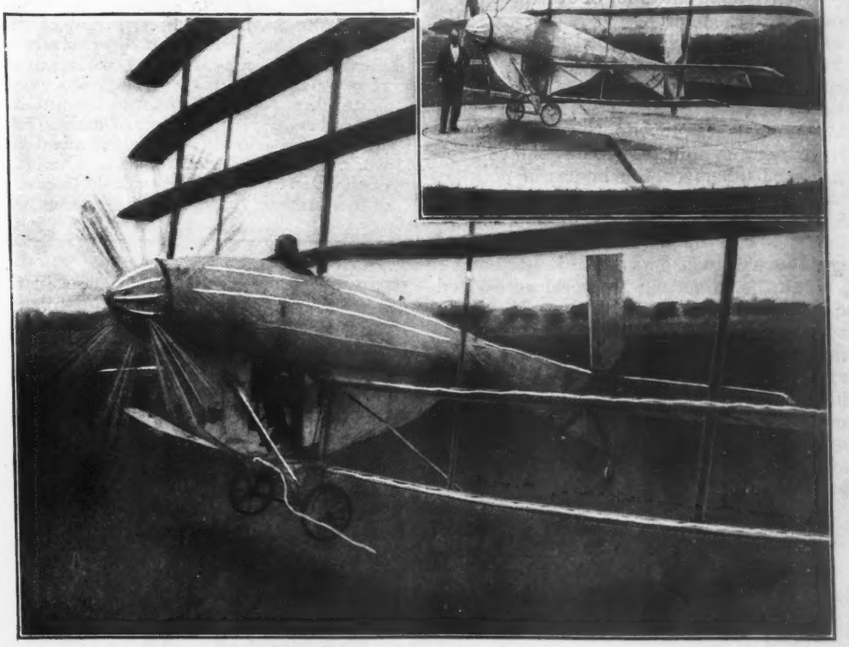
In its test flight the machine traveled 20 feet and rose two feet from the ground.

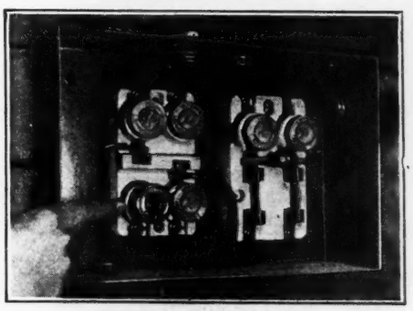
The inventor is convinced that higher gearing, more careful construction and some modifications suggested by his trials will achieve a device capable of rising to comparatively great heights and attaining considerable speed. Future cycleplanes will be much smaller, he asserts.

Right: The 97-pound "bike" flying machine with which the inventor, W. F. Gerhardt, of Dayton, Ohio, recently made a short flight, using only foot power and pedals

Below: An instant in what is said to have been the first flight ever accomplished by a man-powered flying machine. The inventor served as pilot and motor







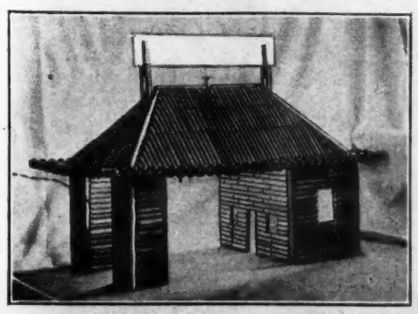
Six Fuses in One Socket

SIX fuses in the space commonly occupied by one is a recently devised convenience for the householder who forgets to keep a supply on hand. When one of the six fuses in the socket indicated by finger is blown out, a turn of the cap attached to it allows the current to pass through a new fuse.

The socket need not be removed.

A "Camera Filling Station"

THIS diminutive "camera filling station," built and displayed recently by C. L. Olds, of Lincoln, Neb., is made entirely of film spools except for four small nails holding together the roof signposts. Eight Christmas tree lights illuminated it in varied colors. A driveway of white crushed rock was used.



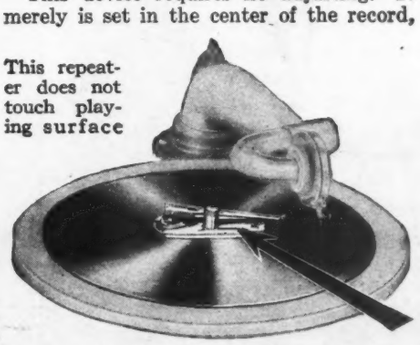
Built of spools and four nails

Ingenious Record Repeater Weighs Less than Ounce

A SIMPLE but ingenious phonograph record repeater, weighing less than one ounce, is a recent invention that makes home dancing without an orchestra more convenient and more enjoyable. It is said to be so simple that a child can attach it without difficulty or damage to the record or to the machine.

This device requires no adjusting. It merely is set in the center of the record,

This repeater does not touch playing surface



over the peg. It does not touch the playing surface of the record at any time, and its action is said to be so shockless and precise as not to endanger the record, needle, or tone arm. It is claimed that no appreciable pause intervenes between the end of the record and the start of the repetition.

As the needle reaches the end of the record, a movable arm, operating on a cam, picks up the tone arm and carries it, so quickly that the eye barely follows the movement, to the starting position. The arm is then returned to its place by a coil-spring. The length of your dance records now is measured by the capacity of your phonograph spring.

A Permanent or Temporary Paper Fastener

BUSINESS papers may be fastened together permanently or temporarily for working purposes by means of this improved fastener. The machine is adjusted simply by turning a little device with the forefinger; when one side of this device is turned up, the staple is pushed through the papers and clinched. When the other side is up, a temporary fastening is made.

Wood of Sawdust and Chalk

USING a mixture of 50 per cent sawdust with chalk and chemicals and subjecting it to extremely heavy pressure, a Norwegian inventor claims to have perfected an artificial wood possessing the toughness of real lumber.

The new substance is said to have the hardness of oak. It can be planed, sawed, bored, painted, and polished.

Our Silent Partners, the Plants

"The Story of Man and His World"

By E. E. Free, Ph.D., and D. T. MacDougal, Ph.D., LL.D.

IN THIS article, the eighth in POPULAR SCIENCE MONTHLY'S fascinating series on Evolution, Doctor Free, Fellow of the American Association for the Advancement of Science, carries us one gigantic step farther in his thrilling story of Nature's growth. This month the author has collaborated with Doctor MacDougal, well known for his valuable scientific work. Doctor MacDougal is Director of the Department of Botanical Research of the Carnegie Institution of Washington.

EVERY human being is a parasite. Whether we like it or not, we must live upon the labor of others. These others are the plants.

Plants supply all the food in the world. They can support themselves by absorbing non-living substances like water, salts from the soil, and gases from the air. We animals cannot do this. We must have more complicated foods, things like fruits or tubers or the bodies of plants, substances like starch or sugar that plants have manufactured, or the flesh of other animals who themselves have lived, in the last analysis, on vegetable products.

If all the animals in the world were wiped out by some cosmic cataclysm, life would still go on. Plants would remain and animal life undoubtedly could be developed again. But if all the plants died, life would disappear. We animals, deprived of the plant hosts on which we feed, would soon starve and the world would be as lifeless as in the beginning.

One Common Ancestor

Both plants and animals are descended, as we saw in the first chapter of this series, from the same creatures, from those little living slime specks on the ancient seashore, which were, we believe, the first form of life on earth. This was perhaps a billion years ago or more. Soon the specks diverged, you remember, into two groups. Some of them learned how to move themselves about and these became the ancestors of animals. Others learned how to make food for themselves out of non-living chemicals in the water, and these became the ancestors of plants. This marked the separation of the two great branches of the tree of life—the animal branch and the plant branch.

The later history of the animal branch we have already traced. We have seen how the descendants of the moving slime specks grew more and more complicated in form and bodily character, how they invented in turn the backbone and legs and warm blood and lungs to breathe with, and all the thousands of inventions that make up that culminating product of animal evolution—the body of man.

Meanwhile the plant branch has been inventive also. Plants have invented leaves, for instance, and strong stems like the trunks of trees, roots to take up water and food materials from the soil, fruits and seeds and flowers, all the thousands of bodily devices that modern plants possess.

The greatest of plant inventions was the first—how to make food of non-living materials. The secret was the use of the energy of sunlight. There still live in the sea vast numbers of tiny floating plants, billions of them in a bucketful of water, that still make food in about the same way, probably, as it was made by their first ancestors.

These plants contain a green substance, the same that gives the green color to all plants. This substance is able to take up some of the rays of sunlight and to use the energy from them to run its food-making machinery, just as a man-made factory uses electrical energy.

Sunlight furnishes, then, the power for the plant food factory. The raw materials come from the water. One of them is water itself, the other is a chemical compound called carbon dioxid. This compound is really a gas, the same gas that makes the bubbles in soda water. There is always a little of this carbon dioxid gas dissolved in sea water and this is taken out by the plant. It and water are built up chemically, by the energy of sunlight, into a simple kind of sugar, that is, into food.

Plants that have come ashore and learned to live in air still make food in this same way.

Every Garden a Sugar Mill

There is a little carbon dioxid gas in air too, and the leaves take up some of it. There is water, too, inside the leaves. This gives the leaf the two necessary raw materials and sunlight provides the power, just as it always has. So the leaf makes sugar out of water and carbon dioxid and sunlight. This feeds the whole plant. Indirectly it feeds us. The process of sugar making is called photosynthesis. It is one of the oldest inventions of living matter and undoubtedly the most important.

Courtesy of *Nature Magazine*, Washington, D. C.

Trapped by the Milkweed

THE remarkable photograph above, highly enlarged, shows how the flower of the common milkweed catches and holds a cluster fly that has visited it in search of honey. The struggles of the insect cause pollen to stick to its legs. If the insect is strong enough to escape, this pollen is carried off to fertilize another flower.

A cluster of milkweed blossoms like the one above is shown in life size in the right-hand picture

The next important invention in the line of plant evolution was that of a resistant body that could not easily be pulled apart. Before this, some of the single plant specks had taken to living together in groups, just as the animal specks had, and had produced thus the first many-celled plants. In the beginning, these aggregates of living cells were stuck together loosely, we may suppose, as the cells of some living water plants still are. Gradually the union between the cells became more permanent. The individual cells developed outer walls of a tough skinlike substance that we call cellulose. Some of them grew long and thin like threads, so that their tough walls held the mass of living cells together. These elongated cells gave the plant strength so that the movement of the water in currents or with the tide would not tear the body of the plant apart.

Just as the animals developed muscles and bones in order to move where they wanted to in spite of the currents, so the plants developed these threadlike cells so that they could sit still and not be torn apart when the water moved.

Most plants still have these thread cells. They hold together the long fronds of seaweed. They are the fibers that stiffen the wood of trees, fibers that we take out and make into paper. The fibers in the flax plant give us linen thread and those in the hemp make rope for us. Similar elongated cells in the seed pod of the plant make the fibers of the cotton.

These three plant inventions were made while plants lived only in the sea. The land, as yet, was bare. But the sea was growing crowded. Food was scarce in it and there was a strong incentive for animals and plants alike to move out onto the shore.

This required, however, fundamental modifications of the body. To a living plant in the ocean the water and the carbon dioxid that it needed for food came to it automatically in the water that bathed it. In the air all this would be changed. New devices must be perfected to meet these changed conditions.

The plant inventors had to go to work again.

The advance of the plant army outward from the sea was slow and tentative. The oldest land plants that we know have been found, as fossils, in the rocks of Scotland. They are probably about 400,000,000 years old. Apparently they were shaped a good deal like the seaweeds from which we believe them to have sprung. Instead of true roots they had merely a bulbous enlargement buried in the soil, somewhat like the root of a present-day mushroom. They had no true leaves, only some rounded stems, that probably were green in color, that may have resembled superficially the stalks of asparagus you buy nowadays in the market.

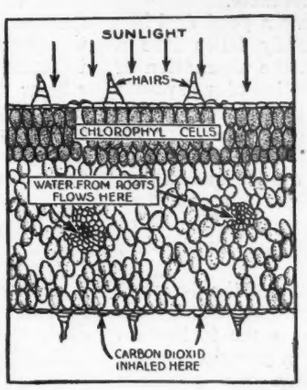
These very ancient land plants had already made, however, two important inventions. They had invented a protective covering, or skin, so that they would not dry out in the air as a seaweed would. They had devised, also, a stiff stem structure, built, as usual, out of elongated fiber cells, so that they could hold their stems upright and thus get more light for use in the manufacture of food.

In the next fifty or a hundred million years these two inventions developed into practically the modern form of plants—the familiar structure of leaves, branches, and main stem. The utility of this structure is that it exposes as much surface as possible to the air and to light, both of which are necessary for the manufacture of food.

At the same time the original bulblike root of the first land plants developed projections and branches, and these grew millions of little hairlike threads hanging on them, so that the plant had a root system, a very large surface, available in the soil through which surface the plant could absorb the water that was no longer provided directly at the surface of the leaves. The impervious skin that was necessary to keep the plant from drying out developed many little microscopic holes, called stomata, through which the gases of the air could penetrate and provide the necessary carbon dioxid gas to the food-making machinery inside.

In the stems and branches there developed long tubes through which the water from the soil could rise (as what we call sap) to the place where it was needed in the leaves. All these changes were devices to expose the leaves (where food was made) to as much light as possible and to provide them with the two necessary raw materials—water and carbon dioxid gas.

It is interesting, in passing, to compare the way in which the animals met this same problem.

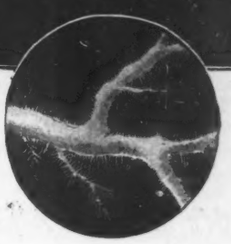


Plant Inventions

(As shown by the peach tree)

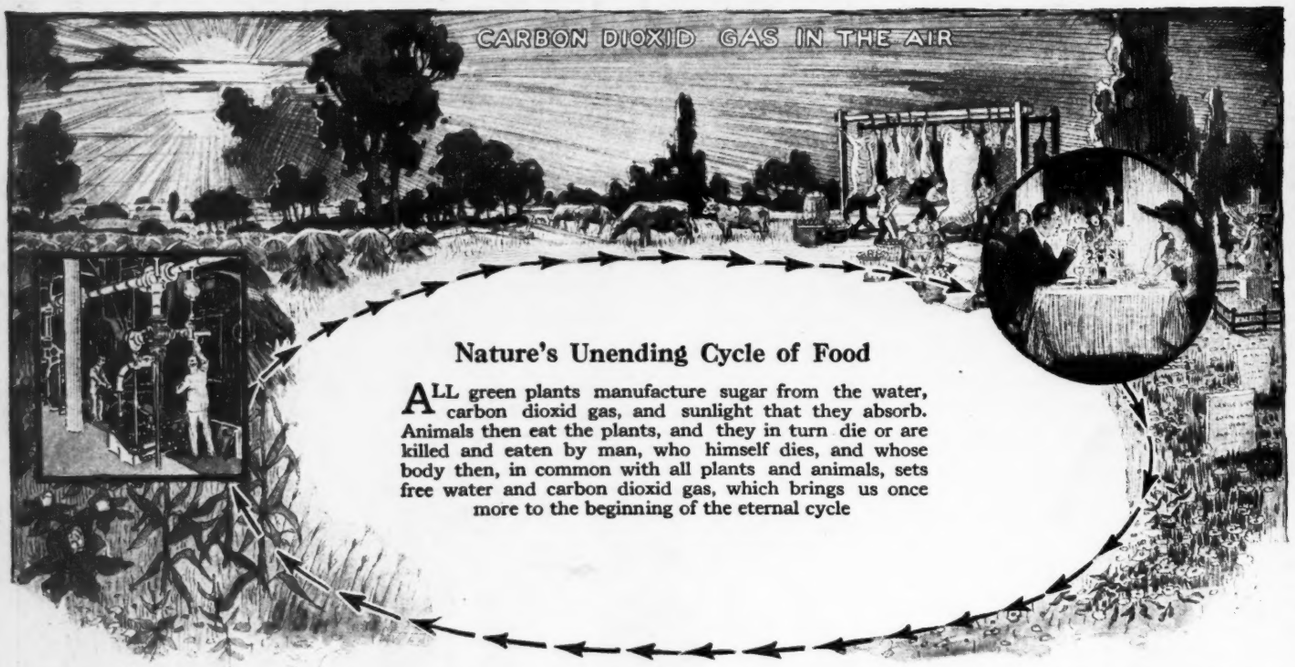
THE many leaves and branches expose the greatest possible surface to the air and sunlight. The widespread root system makes the water from the soil readily available. Seeds are the means used by the tree to propagate its kind, wrapped in a tempting fruit that is carried away by man and animals to other parts and eaten, after which the seed is dropped and later becomes a tree.

At left: Cross section of a plant leaf, showing how the green substance, chlorophyl, manufactures sugar in living plants by absorbing sunlight and combining carbon dioxid and water



Millions of tiny root hairs absorb water and food from the soil.

> Flower in the crannied wall,
> I pluck you out of the crannies,
> I hold you here, root and all, in my hand,
> Little flower—but if I could understand
> What you are, root and all, and all in all,
> I should know what God and man is.
>
> —*Tennyson.*


CARBON DIOXID GAS IN THE AIR
Nature's Unending Cycle of Food
ALL green plants manufacture sugar from the water, carbon dioxid gas, and sunlight that they absorb. Animals then eat the plants, and they in turn die or are killed and eaten by man, who himself dies, and whose body then, in common with all plants and animals, sets free water and carbon dioxid gas, which brings us once more to the beginning of the eternal cycle

Water and carbon dioxid continually are being built into bodies of living creatures and set free

They, too, developed skins that would prevent drying, but they provided for the gas they need, namely, oxygen, by the device of inclosing in their bodies a litle sea water, which became blood. Plants increased their surface (by branches and leaves) so that nearly all the matter of their bodies could come in close contact with the air itself. The animals, with some exceptions like the insects and the earthworms, provided for the forced circulation throughout the body of a fluid blood artificially charged in a special organ, the lungs, with the needed gases of the air.

Life's Marvelous Adjustments

Every creature, plant or animal, that lives on the land and breathes the air is living, really, under conditions to which it is unsuited and in surroundings for which it was not designed. We air-breathers manage to live at all only because of the astonishing inventive genius of life, just as men can live in the Arctic by the artificial expedient of heated houses, or down under the sea in invented submarines.

How successfully the plants managed to live on land and how long ago they did it, is indicated by the fact that about 300,000,000 years ago most of the earth was covered with luxuriant vegetation, the vegetation that produced our coal beds. There were few land animals then. Some insects existed and a few sluggish, crawling amphibians, half reptile, half fish. The land world in those days was a world of plants. Most of the animal life was still in the sea.

But at the end of the coal period the world fell, it seems, upon times of climatic disturbance. The weather, which had been warm and equable all over the earth, became variable. Some countries grew cold, others hot. The seasons, which had been much alike, became sharply different.

There were profound effects, of course, on the forms of life. The plants which had conquered successfully the difficulties of coming ashore had another ordeal to face. How were they to survive the dryness of a long and rainless summer? How could they escape being killed by the winter cold?

They met these difficulties in different ways; but the most successful solution, on the whole, was the invention of the seed. All the seed is, really, is a device to keep the plant alive during an unfavorable season, or, what is the same thing, to start a new plant of the same kind when conditions for life become more favorable.

Certain kinds of plants a good deal like modern ferns had already fallen into a habit of what is called the alternation of generations. One generation of such plants was quite different in appearance from the next one. The first generation, for instance, might be a small creeping weed that lived only a few days; the generation that grew from this weed might be a great tree that lived for many years. The third generation, in turn, would be like the first, and so on.

Out of this habit developed the device of seeds. One of the generations, usually the smaller one of the two, came to live its life, not freely, but as a parasite on the other generation. Then this parasitic plantlet, really the dwindling remnant of the alternative generation, became inclosed in a sort of a case or coat and did not live in the open at all. That is, it became a seed.

If you carefully cut open a bean or pea seed, or any seed, for that matter, that is large enough so that you can see what is inside it, you will notice that it contains a little whitish thing that is really a tiny plant.

When the seed sprouts, it is this little plant that comes out and grows. Most seeds contain, also, some food to provide for this plantlet until it can grow large enough to feed itself. This food is the starchy or oily or "meaty" part of the seed. Cornmeal, for instance, is the food that was stored up in the seeds for the little plants. The plants themselves are the "germs" that the miller takes out and throws away.

Plants Die; Seeds Replace Them

When the cold winters of the years following the coal period clamped down their ice and snow on the land, the large plants died.

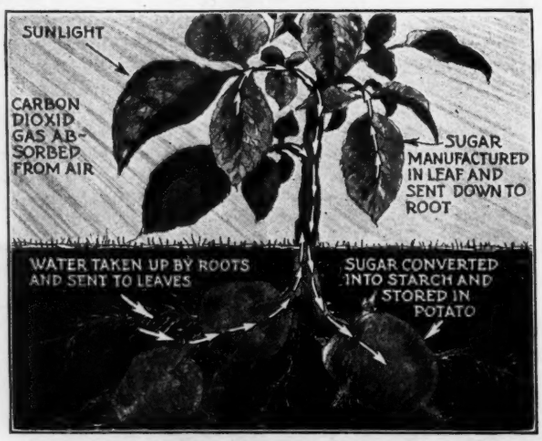
But these plants had left seeds behind them. The seeds could stand the cold. In the spring they were still alive, and as soon as the weather was warm enough, they woke up and started all over again.

The animals, of course, had to meet this same problem of surviving the winter. Some did so by developing the habit of hibernation or winter sleep, a habit which the ancestors of our frogs acquired at this time and which their descendants still possess. Another group of animals—the insects—met the problem in exactly the same way as the plants did, namely by making use of an alternation of generations. This is what the yearly change of grub to butterfly and butterfly to grub really is and this is why it was developed.

But this is not quite all of the story. It is never enough for life, it seems, merely to survive. It must expand, enter new realms, conquer more territory, just as plants and animals advanced out of the sea.

Now the plants, you notice, have handicaps against expansion on the

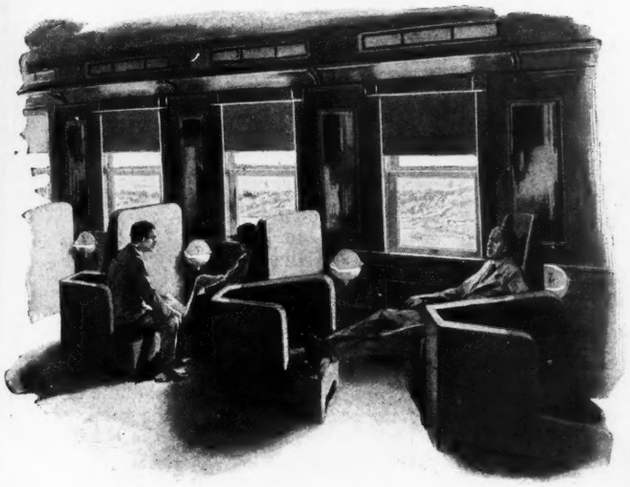
(*Turn to page 118*)

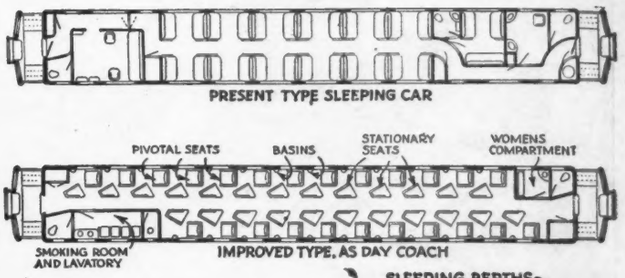

SUNLIGHT
CARBON DIOXID GAS ABSORBED FROM AIR
SUGAR MANUFACTURED IN LEAF AND SENT DOWN TO ROOT
WATER TAKEN UP BY ROOTS AND SENT TO LEAVES
SUGAR CONVERTED INTO STARCH AND STORED IN POTATO

How Nature makes potatoes. The sugar manufactured in the leaves is transported downward into the tubers and there converted into starch for storage

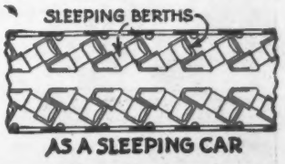
Quick-Change Screwdriver

A Lower Berth for Everybody, Is New Plan





Above: Diagram contrasting the daytime arrangements of the old and new sleeping-car designs. Right: How the new type seats are converted into beds



SPACIOUSNESS and comfort, both day and night, are provided in an ingenious new design for sleeping cars proposed by M. C Krarup, consulting engineer. The illustration above shows two compartments of the car arranged for daytime use. The seat nearer the window is pivoted, allowing a range of positions. The fixed aisle seats double the day accommodations of the car. Twenty-four of these compartments can be contained in an ordinary sleeping car.

AT THE right: The same two compartments converted into sleeping berths. Note the spaciousness, allowing comfortable headroom, a personal wash basin and a large mirror. Bedding is stored in the lower portions of the chairs, and the mattress is produced by lowering the back cushion and extending the seat of the pivotal chair.

The compartments would be separated by partitions of material such as bakelite paper, which is stout and yet can be pulled down from oblique spring rollers in the ceiling. Two would be required for each compartment, one attaching to the pivotal chair and the other, slightly overlapping the first, hooked across the stationary aisle seat. The projecting portion of the aisle seat would be covered. The aisle curtains would resemble the usual drapes now used in sleeping cars.

This Coin-in-the-Slot Radio Is Parisian Innovation

THE penny-in-the-slot machines with ear tubes that had their habitat in depots, amusement parks, and hotel lobbies have, for the most part, disappeared.

With them have vanished the songs they emitted in squeaky jumbles of sound. But the idea they embodied lives today in this French radio machine, which is invading wherever Parisian crowds are.

In cafés, motion-picture theaters, hotel vestibules, steamship cabins, and many other public places, this coin-in-the-slot receiving apparatus is plucking melody from the ether and coins from the purse.

The coin connects the receiving apparatus for a limited time. A card beside the device tells the hours when music is available.

Revolving Sash Facilitates Window Cleaning

WINDOWS with double-hung sashes, that not only can be raised and lowered in the usual manner, but also swing completely around on horizontal pivots, have been designed recently to facilitate cleaning. When tilted at right angles to their normal positions, the entire window space can be used for ventilation. The windows are made for any size of opening and may be installed in any house, old or new.

Tilting them at an angle assures draft-proof ventilation even on windy days.

Safe, easy cleaning with swivel sashes

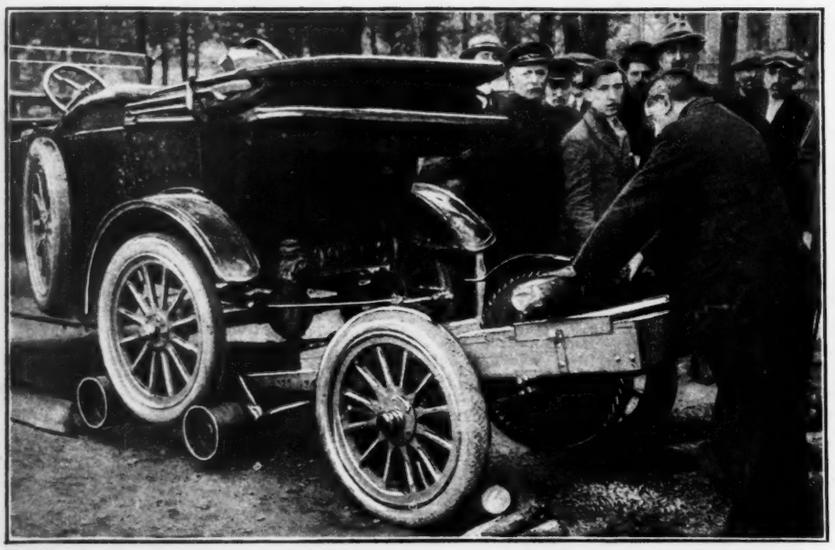
Crimped Shingles Restored By U. S. Forestry Service

Cedar shingles before and after undergoing the new process

A METHOD whereby shingles of cedar and similar wood that have crimped in drying because of excessive moisture may be restored, has been announced by the United States Forestry Service. Since shingles thus damaged are worthless, the discovery promises some really valuable economies.

Crimping is due, it was found, to the collapse of the wood cells that contained the free water. If the shingles are subjected to live steam at boiler pressure for 20 hours and then dried in a kiln at a temperature of 160 degrees, with from 25 to 35 per cent humidity, the crimp disappears.

Making Shoal Water Soundings with Light



Auto Engine Serves as a Sawmill

THE "How My Car Serves Me" prize contest, announced in the September issue of POPULAR SCIENCE MONTHLY, has met with immediate response from our readers who own automobiles. Many of them have sent in letters and photographs describing novel uses to which they have put their cars.

All the way from Paris, France, comes an interesting contribution, an invention of M. G. Schoedlin. The photograph of his ingenious motor-car sawmill is reproduced above. With this saw, mounted on an inclined truck at the rear of the car, he has more than paid for his car. The device is driven by the two rear wheels of the automobile which rest on two friction rollers. When the engine is started, the saw revolves with sufficient force to cut logs of the size ordinarily used for firewood.

Competition in the "How My Car Serves Me" contest closes September 20. For the best letter of not more than 400 words, accompanied by photographs or drawings, we offer these prizes: $20, first prize; $10, second prize; $5, third prize. A number of the contributions will be published next month. Prize-winning letters will appear in the January issue.

Address Automobile Contest Editor, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York City. Each letter will be considered by a board of editors, whose decision will be final.

Quick-Change Screwdriver Contains Three Blades

THE ingenious little tool shown here is called a "lightning-change magazine screwdriver." It has three sizes of blades, contained inside the handle and numbered 1, 2, and 3, according to size. There are three corresponding numbers on the handle, and the blade desired is obtained for use by turning a cap, rotating the handle until the number corresponding to the number of the blade is up, then tipping the handle until the blade drops into place.

A turn of the cap locks the blade into the handle for use and holds it rigid. The blade springs back into the handle when the locking cap is turned in the opposite direction.

These Two-Piece Overalls Are Dustproof

This dustproof overall suit, consisting of jacket and trousers, is said to offer unusual freedom of movement

THIS work garment has all the appearance of the ordinary one-piece overall suit, but in reality it is a two-piece suit so fashioned as to be absolutely dustproof.

The suit consists of a jacket and trousers. The jacket has a waistband under which are tabs which button to the trousers. If the trousers wear out or are hopelessly torn, it is not necessary to discard the entire garment, as would be the case with the ordinary one-piece overall. It would be necessary merely to buy new trousers.

The garment when fastened together may be put on and taken off as a one-piece suit, and when buttoned it is dustproof. It has no bibs, strings, double folds, buckles or catches to bulge and dangle, thus permitting greater freedom of action and making laundering easier.

© Keystone

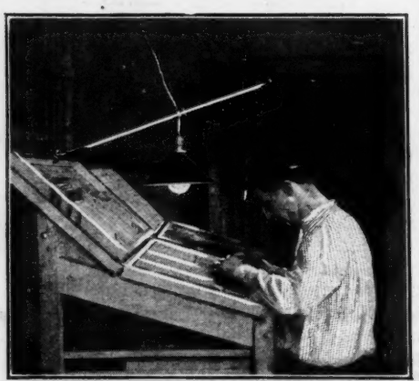
Baby Is Given Fresh Air in Window Cage

BABIES of flat and tenement dwellers, whose tiny lungs have been forced to breathe stale and overheated air, are offered relief by the recent English invention pictured above. A large metal crate is attached to the outside of the window by two stout iron poles. A baby basket can easily be lowered inside. If insects are likely to trouble the child, the crate can be screened.

Droplights Are Adjusted by Simple Arm Device

DROPLIGHTS that swing from the ceiling by flexible wires have always been difficult to adjust to heights and angles such that they throw a maximum amount of light on the proper spot. Any one who has used them in the study, the office, the workshop or the garage has probably been forced to change the height by knotting the cord and to swing the lamp from place to place by tying it with strings attached to walls, joists, desk legs and other places.

A St. Louis man has devised this simple attachment, which permits the droplight to be adjusted as desired. It is a pivoted arm to which the light may be fastened at any point. Swinging the arm up or down or from side to side causes rays to fall wherever desired. A movable clamp permits the arm to be placed wherever necessary.



The light adjuster aids in typesetting

Making Shoal Water Soundings with Light

AN ENGLISH inventor has devised a method of utilizing projected light to determine the depth of water through which a vessel is passing. The device is said to supply an accurate and satisfactory substitute for the time-worn operation of "heaving the lead" to make soundings in shallow water.

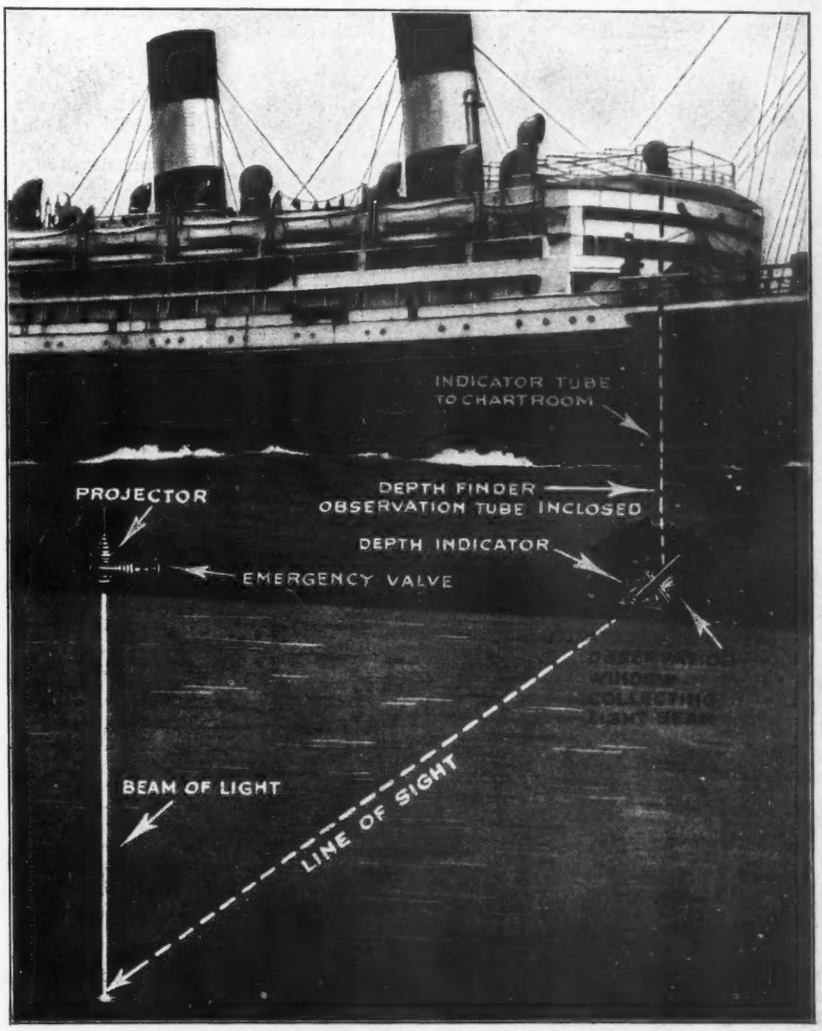
The apparatus consists of two parts. One of these is a projector, which, through a porthole in the bottom of the hull, throws a beam of light directly downward to the bed of the waters. The other part, called the "depth finder," is placed at another porthole some distance from the first in the bottom of the vessel in such a position that the beam of light may be observed plainly. In this manner the angle between the line of the beam and the observer's line of vision is recorded accurately.

How Depth Is Determined

Running perpendicularly from the chartroom is a tube connected with the depth finder. By an arrangement of mirrors the ray of light is reflected through this tube so that it can be observed continuously by the navigating officer. After the apparatus has recorded the angle between the light beam and the line of observation, a simple calculation determines the depth of water beneath the vessel with absolute accuracy.

The apparatus, of course, cannot be used in sounding the depths of the ocean, for it is impossible to project a ray of light powerful enough to penetrate to the bottom. But it is entirely efficient in rivers, and other shoal waters where frequent soundings are necessary to a vessel's safety.

Soundings can be taken with this instrument under any weather conditions and at any speed. The necessity for "slowing down," as with the prevailing method, is obviated. The only instance in which it could not be used would be in the rare event of the failure of the electric current.



How beam of light, projected downward, makes soundings. Depth is determined by mathematical calculations based on the angle formed by light beam and line of light

Chicken Incubator Used in Cheesemaking

AN ORDINARY chicken incubator has been used with striking success to test milk in cheesemaking by J. L. Sammis, of the Wisconsin College of Agriculture, shown above with his testing apparatus.

Milk samples are placed in test tubes in the incubator and subjected to heat of a temperature favorable to the development of bacteria. The samples are tested, and the milk is accepted or rejected, according to its reaction to the heat.

Gyroscopic Indicator Makes Night Flying Safe

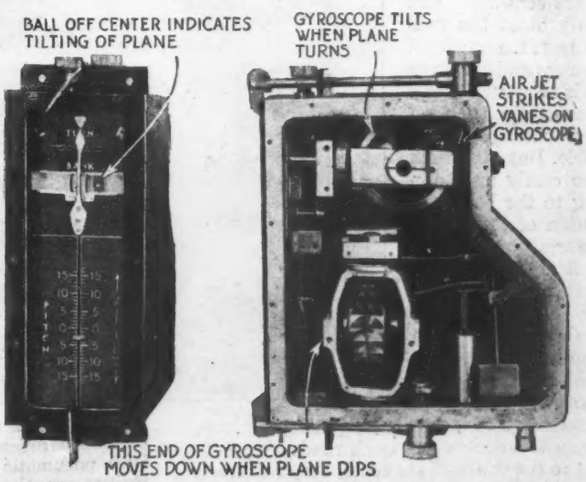
PERILS of flying by night, or in clouds have been lessened by a new gyroscopic indicating instrument recently perfected by the United States Army Air Service at McCook Field, Ohio. It consists of two gyroscopes with axes at right angles to each other, and a glass tube resembling the bulb of a carpenter's level.

The turn-indicating gyroscope has its axis horizontal and parallel with the wings. A turning of the plane to the right causes the top of the rotating gyro to tip to the right, actuating a pointer that shows the amount which the plane has turned.

The pitch-indicating gyroscope also is mounted on a horizontal axis at right angles to the first. A downward pitch of the plane causes the registering end of the axis to move down, and the pointer shows on a scale the amount of dip at which the plane is descending.

When the plane is moving horizontally, all scales read zero, but as soon as one wing drops lower than the other, the ball within the gage glass moves to one side.

Both gyroscopes are turned by a jet of air that is shot against vanes formed in the rims of the wheels. This jet of air is produced by the suction of the wind.


BALL OFF CENTER INDICATES TILTING OF PLANE
GYROSCOPE TILTS WHEN PLANE TURNS
AIR JET STRIKES VANES ON GYROSCOPE
THIS END OF GYROSCOPE MOVES DOWN WHEN PLANE DIPS

On the face of the indicator (at left) pointers register turn and pitch, while a level indicates tilting of plane. At the right, interior of the device, showing the two gyroscopes

Roof Railway Aids in Cornice Work

At the left, the roof railway, showing handcar with counterweight and balanced ladder suspended over the edge of the building. Below, the moving ladder and platform from which workmen replace lights on the cornice

TO FACILITATE the work of changing electric lamps for the cornice lights of its building, the *Seattle Times*, of Seattle, Wash., has installed a small railroad on its roof. The *Times* found that the many cornice lamps illuminating the building were difficult to replace, sometimes requiring 10 hours of labor. Other problems of work about the roof also were troublesome, and as a result the railway was decided upon.

Steel tracks were laid on the roof, running all around the edge. On these tracks a three-wheeled hand car is operated. On the inner side the car carries a 200-pound counterweight. The outer side supports a ladder designed to hang over the edge of the roof. At the bottom of this ladder is suspended a small railed platform on which the workman rides.

Standing on this platform the worker moves quickly from lamp to lamp, while helpers push the car along the track. Instead of the 10 hours formerly required to change the lights, the work is now done in two hours.

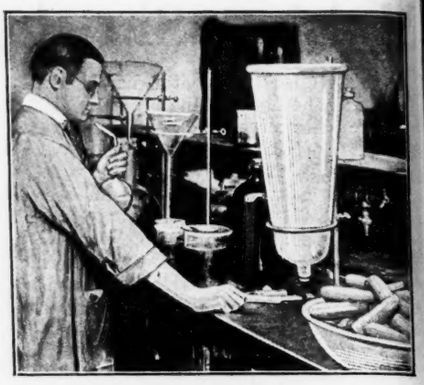
The amount of work saved and the greater comfort and safety of the workman can be realized from the fact that formerly attention to the cornice lights meant 110 trips over the side of the building on a small ladder.

Air Cushion Seats Designed for Motor Buses

OMNIBUSES with seats that rest on pneumatic shock absorbers promise to solve one of today's greatest passenger transportation problems in rural and suburban districts. Country roads are not always in first class condition, and to protect the passengers from painful bumps and shakings it is necessary to use pneumatic tires on the wheels of a vehicle. But such tires are costly and, owing to the bad condition of the roads, have a brief life.

A new type of seat, recently placed on the market, makes it possible to employ solid tires without exposing passengers to the discomfort of shocks, and perhaps injury, when traveling over rough roads. According to the width of the seats, they rest upon one or two valve-controlled pneumatic shock absorbers acting through springs. The cushions consist of two telescoping metal cylinders, carefully machined so that they fit practically airtight when lubricated. They are said to be so efficient that passengers may read without undue eye strain.

Interior of new easy riding omnibus with seats equipped with pneumatic shock absorbers, as shown at the right. An air cushion inclosing a spring absorbs the jolts over rough roads



Spurned Corncob Rises to Dignity of Wood

YOU, who have thought of corncobs only as holders provided by Nature from which you might nibble the sweet kernels, should be interested in the recent discovery by Professor Darling, of Milliken University, Decatur, Ill., of a process by which 60 per cent of the cob can be manufactured into a substitute for wood. Professor Darling is shown above in his laboratory, making his synthetic wood.

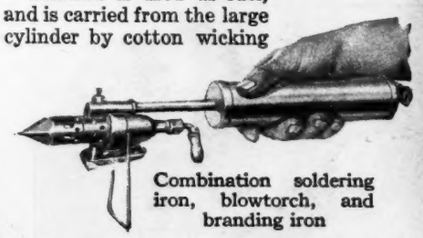
The cob is ground to a flakey, fibrous pulp and, after being mixed with a suitable binder, is compressed by a powerful hydraulic press.

The finished product can be whittled, glued, nailed, screwed, shaved, or turned on a lathe without danger of chipping. It will withstand a pressure of 10,000 pounds to the square inch. It can be stained and varnished like ordinary wood.

A Blowtorch that Solders and Brands

A COMBINATION soldering iron, blowtorch, and branding iron, which is self-heating, of light weight, and little more than a foot in length over all, has been developed by an Illinois manufacturer.

Gasoline is used as fuel, and is carried from the large cylinder by cotton wicking to the flame tube through which it is fed by a patented needle valve and vaporized.



Combination soldering iron, blowtorch, and branding iron

A special alloy steel tube connects the fuel tank with the burner in order to keep the tank cool at all times.

The device may be adapted to any of its three uses by a simple adjustment. The fuel feeding is said to be so arranged as to insure safety to the user.

Handwriting Telegraphed

TELEGRAPHIC transmission of written script—1453 words in six minutes—was accomplished recently by a new French invention. The handwriting was sent from Lyons to Malmaison, near Paris. Ordinary transmission of such a message by telegraph would have required 25 minutes. The promoters of the new device plan to make it available soon for the use of the French public.

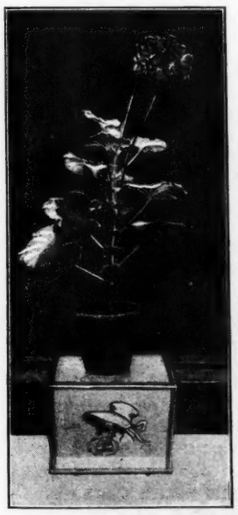
Is a New Ice Age Coming?

Bicycle Searchlight Made with a Flashlight

A BRACKET that permits an ordinary pocket flashlight to be utilized as a searchlight by a bicyclist has been invented by Clarence E. Graves, of Hammond, Ind. It is a strip of sheet metal fitting the circumference of the flash lamp, to which it is secured by a bolt and thumb nut. It is fastened to the handlebar by one of the bolts that engage the bar at the head of the bicycle.

Adjustable Window Shelf for Flower Pots

FLOWER lovers who are city dwellers will warm to "Betsy Bobbit." The young lady is an attractive adjustable shelf, which makes it possible to have a flower pot on even the narrowest windowsill.



The device is of metal, sturdily built, and capable of supporting a pot weighing 20 pounds. It hooks over the sill, between the sash and the sill, and does not interfere with raising or lowering the window. The retaining strip gives the strength necessary to support pots heavier than 12 pounds. It is fastened to the apron or facing of the window by a few tacks and the slanting piece then is engaged in it.

The invention is easily slipped into place, and its inner support, made attractive by a hand-painted picture of an old-fashioned girl, lends itself well to any home interior.

Gracing bare windows with flowers gives charm to the dingiest and least inviting of exteriors. And flowers in windows, never sun-hungry, always thrive.

Nerve Splicing Is Achieved

NERVE splicing, said to be the most delicate of surgical operations, is one of the latest achievements of curative science. Nerves from animals may be used to restore health and activity to human muscles and other body parts suffering from nerve loss or disease.

A Mobile New Pump with Many Uses

AN ENGINE-DRIVEN double - cylinder pump, mounted on automobile wheels, so that it may be moved from place to place by automobile, motorcycle, or motor truck, or drawn by hand, has been perfected by a Pennsylvania manufacturer. The device is said to adapt itself to a variety of uses.

This easily transported pump, with its capacity of 80 gallons a minute, can fight fires or empty flooded basements

It may be used for any purpose for which a pump is necessary, in construction work, in repair work, or in irrigation. Its mobility adapts it for general pumping utility about a farm or industrial plant. It is, moreover, a particularly effective piece of fire-fighting apparatus. Industrial plants and small towns could find inexpensive fire protection in it.

The engine develops five horsepower, and the double cylinder assures a continuous stream. This stream can attain to 80 gallons a minute. A single, half-inch stream may be directed from a half-inch fire nozzle on a blaze at a considerable distance. For fires closer to the machine, two high-pressure streams may be used. The suction hose is adapted for quick and convenient use in lake, creek, well or in any flooded place.

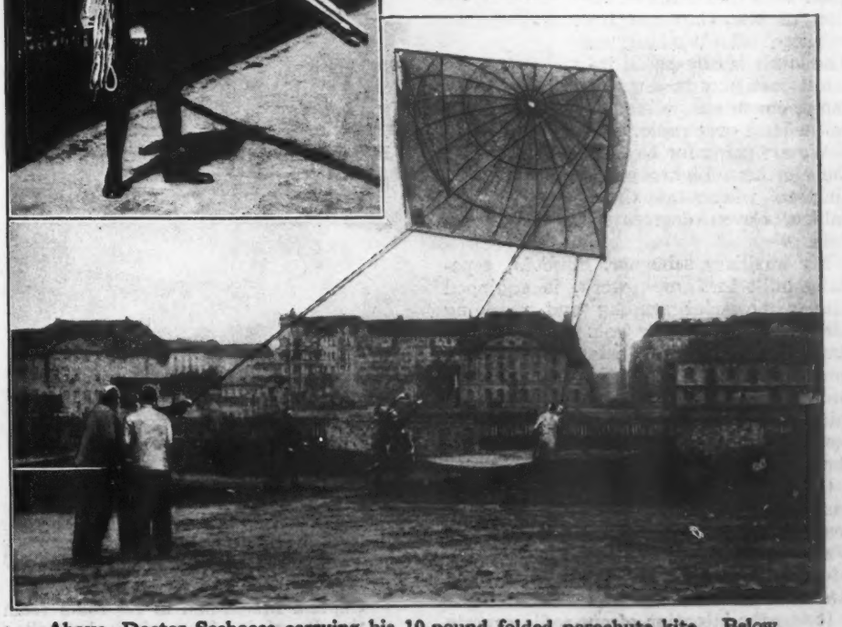
The pump and engine are securely mounted on steel, thus permitting the device to be safely transported at high speed over rough roads. The apparatus weighs 1300 pounds, completely equipped.

Inventor Soars in a Ten-Pound Flying Device

INVENTING a 10-pound flying machine and then flying with it was the daring exploit performed recently by a German inventor, Dr. I. Seehaase, who is shown here with his folded diminutive gravity-outwitter over his shoulder. The other picture shows the same device being handled in a high wind by attendants in preparation for a flight.

This invention is said to be the smallest and lightest flying device with which man ever has ventured into the air. It is a sort of parachute kite, ruggedly but lightly and compactly constructed. It is said to be perfectly safe, even when the wind dies while the aviator is aloft, since its parachute nature permits an easy descent.

Flights of considerable duration are said to have been accomplished by the inventor, in spectacular tests in Germany.



Above, Doctor Seehaase carrying his 10-pound folded parachute kite. Below, attendants about to release the retaining ropes for a flight by the inventor

Atlantic are increasing in area and adding

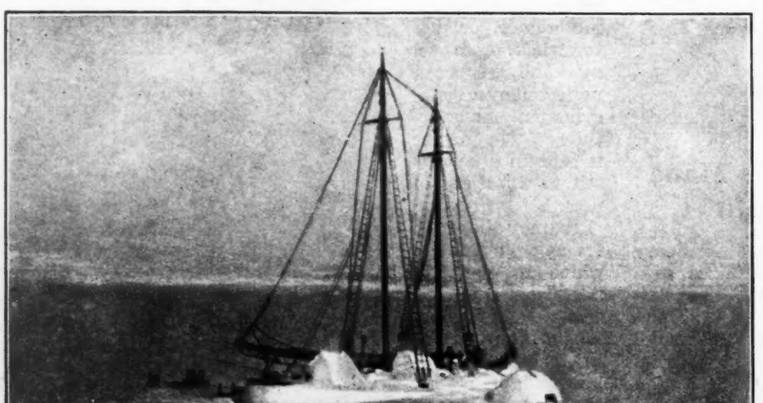
Is a New Ice Age Coming?

Famous Polar Explorer Taking Radio into the Bleak Arctic

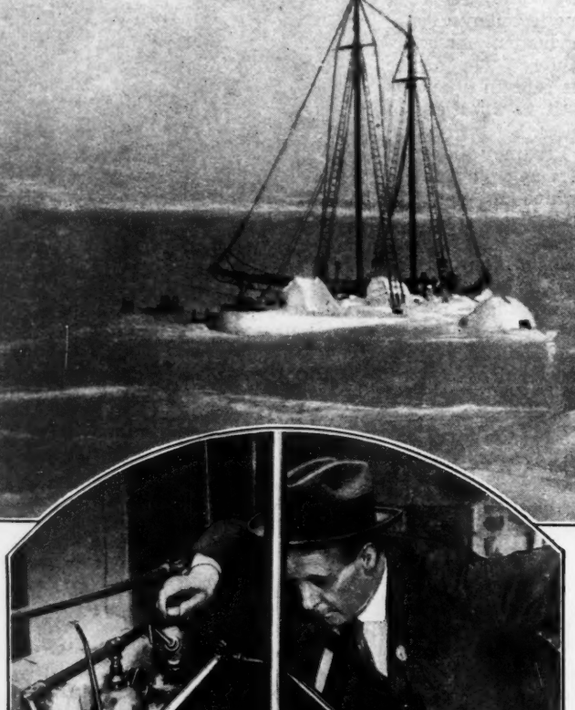
By Captain Donald B. MacMillan

When the following special article was received in the office of this magazine, the explorer already had embarked on his eighth expedition into the Arctic to determine, among other things, whether another Ice Age is beginning.

Captain MacMillan is preëminently fitted to discuss this fascinating question. He has missed only two of the last 15 years in the Arctic. In 1908 he voluntarily relinquished his position as a college professor to sail north with Peary on his memorable dash to the North Pole. His observations concerning the advance of the glaciers in the Far North, and the reasons offered by science, will interest every reader.



The *Bowdoin* frozen in during MacMillan's last Arctic trip in 1921



Capt. Donald B. MacMillan tuning up the engine of the *Bowdoin* for his present trip to the Far North

IT IS always of interest to me upon my departure for the Arctic regions (this is my eighth) to learn just what particular phase of our projected work appeals most especially to the public. This year it happens to be the possibility and the probability of another glacial period.

That subject is of great interest, but not more so than the subjects of terrestrial magnetism and atmospheric electricity, in both of which we hope to do good work under the direction of the Carnegie Institution of Washington. The latter is of especial interest just now in view of the tremendous wave of enthusiasm over radio.

We are going far beyond the Northern Lights, planning to winter at Cape Sabine, eleven degrees from the North Pole.

My auxiliary schooner, *Bowdoin*, especially built for arctic work, is equipped with a powerful sending and receiving wireless outfit. In our tests we have heard stations 2500 miles distant, and have communicated with stations in Virginia and the Far West, thus assuring success in this branch of our work if we can penetrate the auroral belt that encircles the globe at about 55 degrees north latitude.

On my last trip, when two degrees beyond the Arctic Circle, every night I heard distinctly the Arlington station at Washington, D. C., and this with a much inferior set than now installed in the *Bowdoin*.

It was the intention of our radio experts to use copper strips on the bottom of the *Bowdoin* as a ground. We decided, however, that the 1700 steel plates on the bow with which we crush and ride over ice will serve the purpose equally as well.

Captain MacMillan in his radio room on the *Bowdoin*, from which he will send messages from the Far North

All of our best and ablest geologists declare that we are at the close of a great glacial period when the northern part of North America was covered with 4,000,000 square miles of ice. The first great icefield was developed about 500,000 years ago. Since that time there are very good reasons for believing that we have had three more great glacial stages, each lasting 25,000 years, with interglacial stages averaging 125,000 years. What is the explanation of these climatic changes? Many and sound reasons have been advanced, among which are:

An increased degree of ellipticity (the oval shape) of the orbit of the earth.

A change in the obliquity of the elliptic.

A change in the position of the earth's axis of rotation.

An actual sliding of the external crust or shell around its fluid nucleus.

A continuous change in the distribution of land and sea.

A periodical elevation and subsidence of the surface of the earth.

Why Not another Ice Age?

Since we are absolutely certain that we have had four or more great glacial stages, no good and sufficient reasons can be advanced why we should not have others. The glaciers in the Alps are all retreating, those of the Chamonix Valley from one quarter to one half mile during the last 10 years. The glaciers of Alaska also are lessening in bulk. The Muir Glacier has retreated seven miles in 20 years. Therefore, it comes as a surprise to geologists when I tell them that all glaciers in the Far North are advancing, and have been for at least the last 70 years, as clearly proved by the maps and accounts of our early explorers.

My own observation during the last 15 years confirms this. If they are advancing, why? Is it due to an increase in humidity resulting in an increase in snowfall, or a re-elevation of the northern lands? Mountains are being covered, valleys are being filled, coastlines and islands obliterated. Vegetation is being killed, animal life consequently being destroyed, and the icefields of our North

Atlantic are increasing in area and adding to the dangers of navigation.

Greenland has an area of 600,000 square miles. Today 500,000 are covered with ice. A covering of the remaining 100,000 will influence life considerably, in that millions and millions more tons of ice will drift southward yearly to cool our waters and lower the mean annual temperature.

Ellesmere Land, now slowly being ice capped, will aid in bringing about this result. The result will not be marked until the hundreds of glaciers now filling the valleys reach the sea, when each will send out its fleet of icebergs to add to the already congested northern waters.

How rapidly are these glaciers advancing? This is one of the purposes of my expedition—to mark clearly for future reference the faces of many of our largest glaciers. When other explorers return in future years, they can bring us back something definite. Had Kane, Hayes, Hall, Greeley, and Peary done this, they would have made invaluable contributions to science.

WITH this promise to Science, Captain MacMillan's article concludes. What are the potentialities of the information he submits?

For the first time in the history of polar exploration, as Captain MacMillan modestly states, his expedition will plant landmarks in the vast fields of arctic ice to permit scientists of the future to forecast exactly when the earth will know its next Age of Ice, when a great portion of northern North America may lie buried like the poles beneath huge mountains of solid ice; when vegetation may disappear from the Northern Hemisphere; when man and animals may die and the earth be habitable only near the equator.

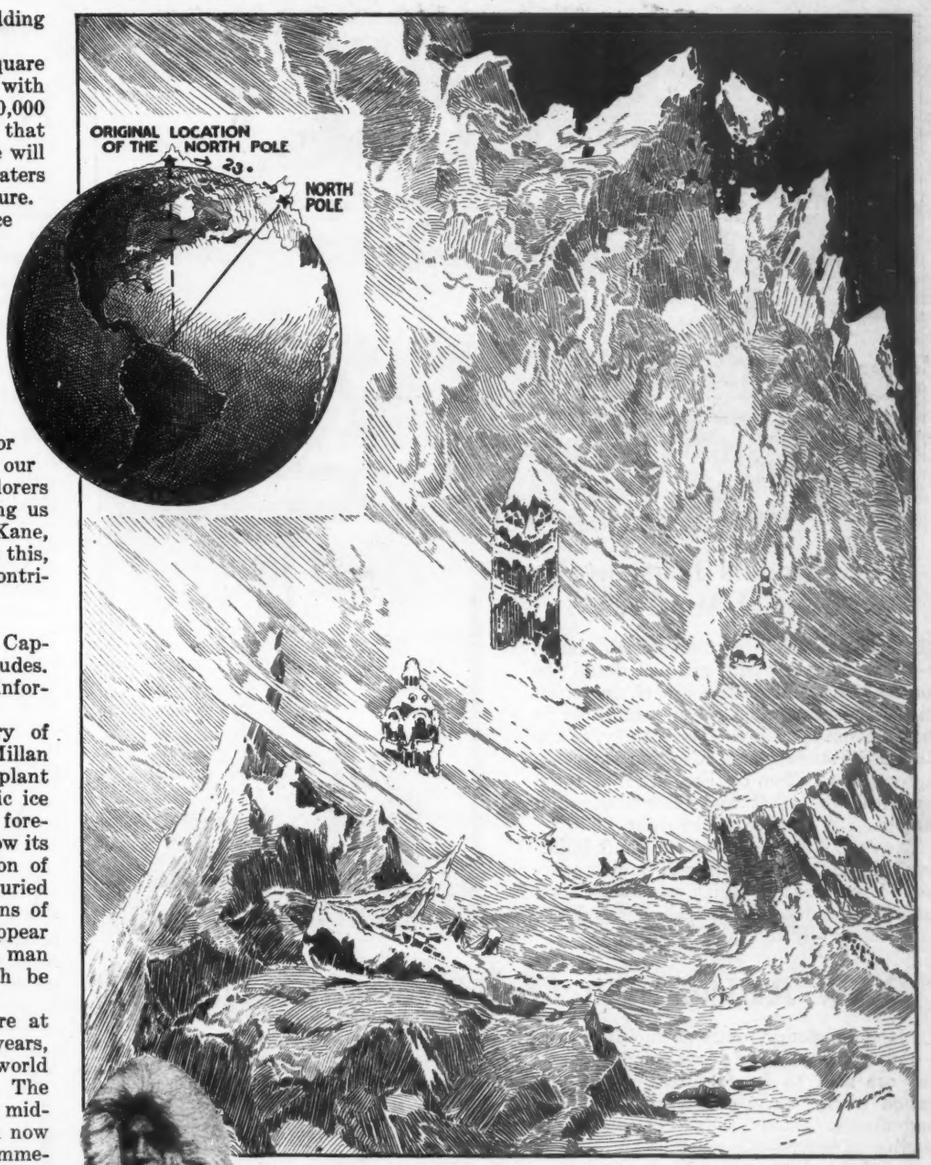
Science tells us that today we are at the end of a glacial period of 25,000 years, one of three to five such periods the world has known in a half million years. The interglacial periods—those when the midlands of our globe are as we see them now—last for 125,000 years or more, so immediate fear need not enter into our consideration of the possibility of a return to the Age of Ice.

While science can only theorize as to the cause, it can tell almost with certainty the history and effect of the previous glacial periods. Their stories are written in the face of the earth; in the contours of mountains, the beds of streams, the shore lines of inland waters, the depths of valleys. For when billions of tons of ice move irresistibly over the land, they hew, cut, and carve from their path anything that threatens to halt their progress, smoothing the mountain faces, leveling the hills, gouging out the valleys and altering the cliffs.

The next Age of Ice may obliterate a civilization that it has taken mankind centuries to achieve. Great cities may be swept away before the relentless march of the glaciers. The crumpled stones of their tallest structures may be returned into the earth whence science snatched them or carried on by the flood waters of the melting period into the seas.

Possibly this happened in the last age of ice. Possibly before that time America, Europe, and northern Asia knew a civilization beyond that of which we are now so vain! The present sum total of human knowledge may have been surpassed prior to the last advance of the devastating ice. All the scientific discoveries that make our lives pleasant and safe may have been in the hands of the ancients whom the last glacial period removed from the earth.

These fascinating mysteries of the past and the future lend special interest to Captain MacMillan's expedition—an interest that has been heightened, from the standpoint of the public, by the present widespread use of radio. Radio enthusiasts all over the country are ready to tune in on WNP—"Wireless North Pole"—the call number assigned the *Bowdoin*, which carries the first broadcasting station ever to move over arctic ice.

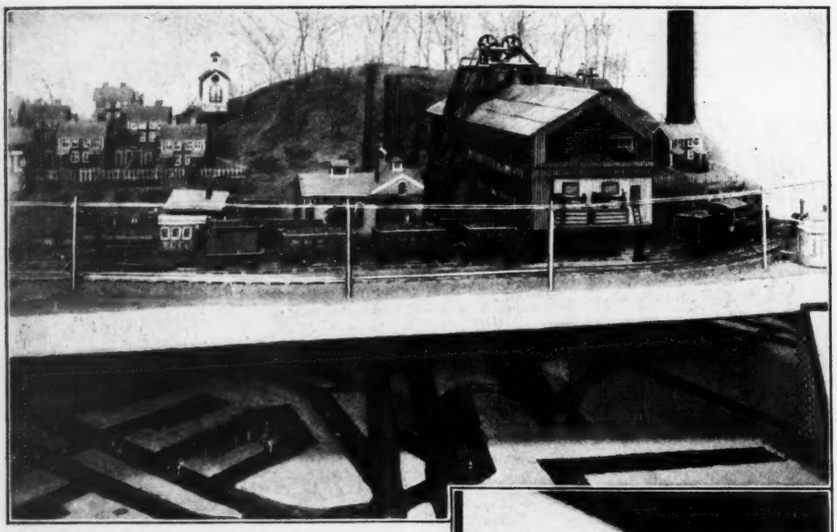


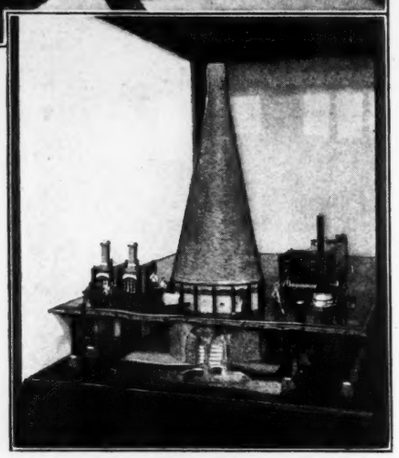
How our artist pictures the next great Ice Age. The glaciers, in their relentless advance, sweep away and crumble the tallest skyscrapers of our cities, blotting out the modern civilization built by science. The inset illustrates one of the scientific explanations of glacial periods—the change in the earth's axis of rotation and consequent shifting of the poles

Will our descendants wear clothing like this? Here is Captain MacMillan dressed in a "parka" of arctic furs

Radio Expert of the Expedition

Hiram Maxim, dean of all radio amateurs in America, was responsible for the selection of Donald Mix, of Bristol, Conn., as the radio operator of the expedition. Mix's fellow members of the American Radio Relay League have agreed to do their best to maintain communication with WNP at all times. Messages from the *Bowdoin* will be broadcast by transmission from WJAZ station in Chicago. In addition to keeping the world informed as to the progress of the expedition, the *Bowdoin's* radio equipment will permit the crew to listen in on the popular radio programs, a diversion new to polar expeditions.





Tiny Models Illustrate Industrial Methods

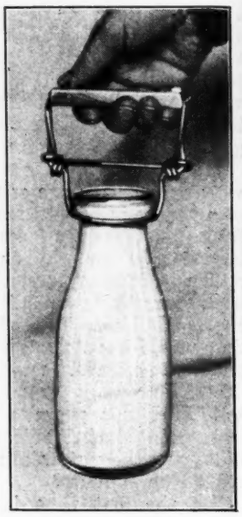
LITTLE models of industrial plants, revealing in easily grasped detail the construction and operation of factories, mines, furnaces, etc., are on exhibition in the Division of Mineral Technology, in the United States National Museum at Washington, D. C. Two of these are illustrated herewith—the shaft coal mine above and the pot glass furnace at the right.

The model above shows the shaft buildings, tipple, miners' houses, and underground workings in which miners are seen cutting coal by machinery, every detail built accurately to scale.

Safe Milk-Bottle Carrier for Children

NO LONGER is there any reason why four-year-old Buddy should go forth to the store with a dime, some pennies, and a milk bottle and come back sobbing in a few minutes, penniless and milkless, except for what is splashed on him. Unless he falls down, the bottle carrier here shown will safeguard against childish carelessness.

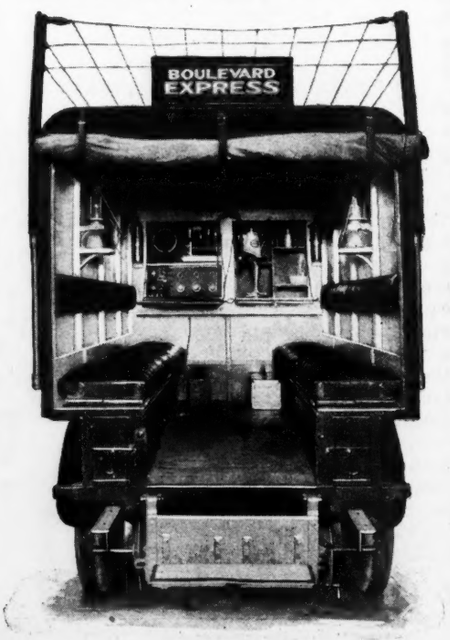
This carrier holds the milk bottle securely once the wire cross piece has been locked in place. The grip may be adjusted to fit a bottle neck of any size, and the wooden handle gives comfort to the one carrying it, without danger of slipping.



The handle in use

A Wireless Service Truck Answers "SOS" Calls

A WIRELESS sending and receiving set has been added to the equipment of the service truck operated by a Los Angeles transportation company. This truck is stationed halfway between Los Angeles and San Diego, Calif., keeping in touch with the home station, so that almost instantly it can be advised of a company truck in need of repairs along the road between the two cities. It also answers distress signals from private cars, the owners, of course, paying the standard rate for whatever help is rendered.



Note wireless set installed in truck

The owners of the service truck believe that before long such wireless equipped repair cars will be maintained on principal highways all over the country.

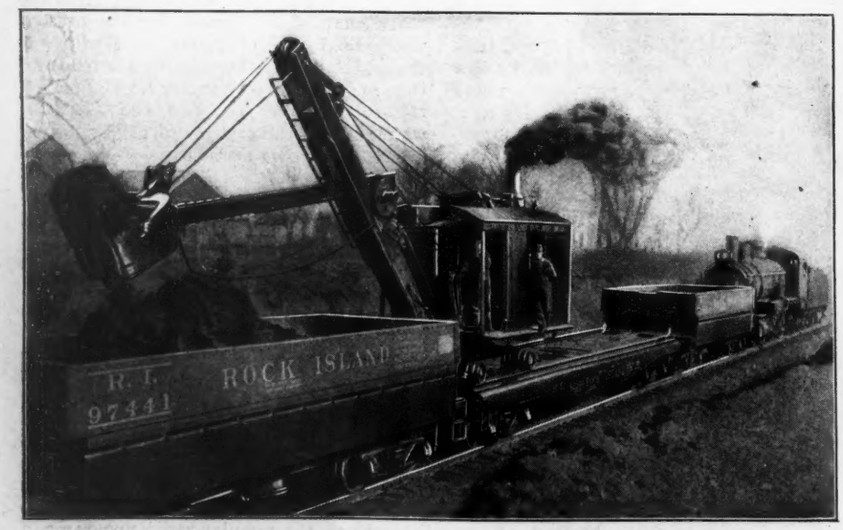
New Railroad Ditcher Is Versatile Machine

HIGH efficiency, extreme mobility and versatility, and low maintenance cost are said to be features of the improved heavy duty, revolving type railroad ditcher shovel shown below. It is possible to mount this machine on railroad trucks of standard or special gage, traction or continuous tread trucks. This adaptability makes the same machine available for use in cleaning ballast, laying rails, ditching rights of way, loading and unloading, and stocking coal. It may also be used as a locomotive crane and has numerous other utilities.

The machine also is designed for ready conversion to a steam shovel, crane, single line clamshell, or dragline outfit. All points exposed to intense stress are reinforced.

Relief for the Rheumatic

MORE than 4000 sufferers from rheumatism are said to have enjoyed an 80 per cent amelioration of symptoms under the bacteria injection treatment given 5000 patients during the last four years at the clinic of the New York University Medical College. In several instances the improvement effected is said to have been equal to a cure.



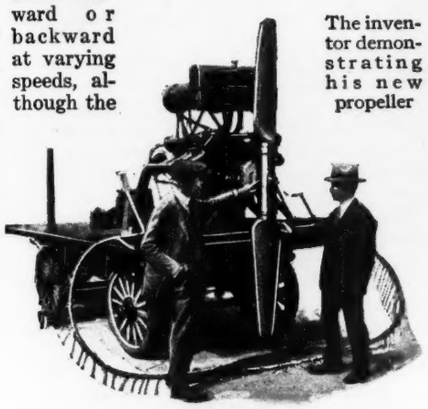
Wide use of this new railroad ditcher, because of its remarkable mobility and versatility will, it is claimed, render unnecessary many machines now in use

Monobus May Bring Cheaper Rides

Airplane Speed Controlled by Adjustable Propeller

SHOWN below is Spencer Heath, of Baltimore, Md., demonstrating to Major-General Haraguchi, of the Japanese army, his recent invention, an airplane propeller with adjustable blades that may be altered in pitch simply by pushing a button. This feature is said to make possible a wide range of speed as well as to provide an effective brake to be used in landing.

Mounted on a trailer truck, the Heath propeller proved capable of driving the truck forward or backward at varying speeds, although the blades revolved at full speed throughout. One adjustment enabled the truck to remain stationary while the propeller was revolving swiftly.



The inventor demonstrating his new propeller

Among the advantages which the inventor claims for his propeller are these:

It provides aircraft with a variety of speeds, instead of only one speed, as at present. It supplies a brake when revolved in a reverse direction, and in consequence obviates the necessity of a long run in landing. It permits tuning up the engine of an airplane without the necessity of checking the plane; for, when set at neutral, it produces no forward impulse.

Metal Chain Will Prevent Finger Sucking

SMALL children can be cured of the finger-sucking habit if an arrangement of bands and dangling metal links is clamped around the end of the thumb or finger, says the inventor of this device.

When the child attempts to put the finger, with band and chain attached, into its mouth, the metal parts come in contact with the tongue and the roof of the mouth. The result is unpleasant, but not painful.

After experiencing this disagreeable sensation a few times, the child will be cured of the habit, the inventor claims.

Dangling links hung from metal bands discourage thumb sucking by infants

New Parlor Golf Game Played with Manikins

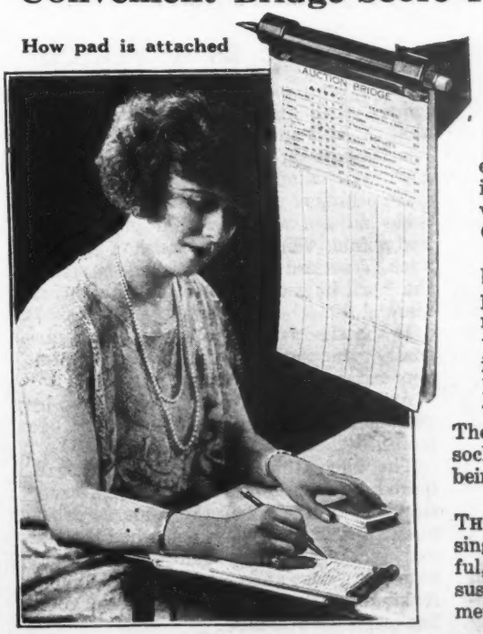
MANIKINS that play real golf on the parlor floor, under the control and direction of players, feature a new indoor golf game that includes tees, greens, bunkers, and even the water hazards of the outdoor game.

The game is played with a club resembling a driver, which has the figure of a miniature golfer in place of the usual wooden head. The arms of the manikin are pivoted, so that when the player pulls back a lever in the club handle, the doll swings a tiny golf stick and strikes a small celluloid ball.

Considerable skill is required. If the little player is not directed properly, he will foozle completely. Length and direction of the strike both are in the player's control.

Convenient Bridge-Score Pad Clamps to Table

How pad is attached



EVERY one who plays bridge knows what an annoying article the score pad is. Sometimes you can't find it when you're ready to play. When you have found it and have started the game, the pad is likely to evidence an exasperating habit of traveling around the table, getting mixed up with the cards, or falling to the floor. Or the pencil may be lost.

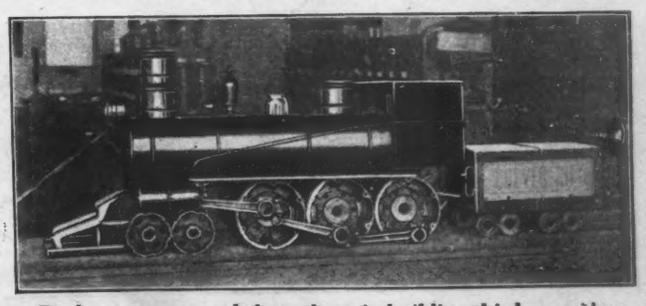
These annoyances are eliminated by a bridge-pad holder that recently has been put on the market by a Connecticut manufacturer. A spring clamp holds the pad securely to the table, so that it is always ready for use at the score-keeper's side and can be written on without being held in place by the hand. The outfit includes a refillable pencil and a socket for the pencil that prevents it from being mislaid.

THE number of living organisms in one single gram of soil, no more than a teaspoonful, exceeds 40,000,000, according to a census taken at a British government experiment station.

Midget Locomotive Made of Old Ford Parts

A MINIATURE locomotive constructed of Ford parts is attracting attention at Culver City, Calif., where it is being displayed by De Witt Brady.

The connecting rods are the only parts used in the motor car that serve the same purpose in the locomotive.



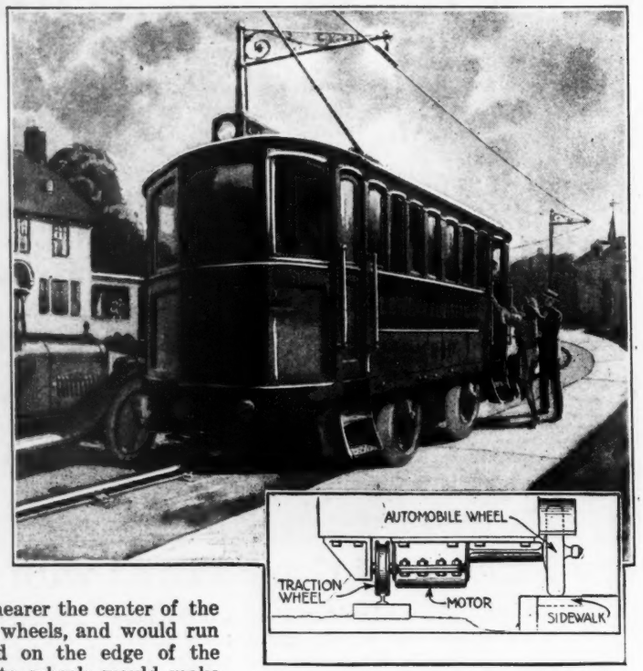
Ford parts were used throughout in building this locomotive

Monobus May Bring Cheaper Rides

THE monobus, a hybrid of trolley car and autobus, has been suggested as the possible solution of transportation problems in suburban districts. By its use the cost of installation and expense of maintenance could be reduced, it is claimed, to the limits demanded by infrequent trolley service in thinly settled communities.

The monobus would be supported by two trolley-car wheels and two bus wheels. The trolley-car wheels would be located nearer the center of the bus than the truck wheels, and would run on a monorail laid on the edge of the highway. The auto wheels would make use of the paved or dirt areas. Rapid transportation would thus be confined to one side of the road. Very little pavement, if any, would need to be broken to prepare the railbed. Either an overhead trolley driving electric motors, or gas engines, could be used for motive power.

The main advantages claimed over an automobile bus are a diminished wear on roads, and reduction in tire cost, since there would be but two tired wheels, on which only 40 per cent of the load would fall.



Our artist's conception of the proposed monobus. The diagram illustrates how one rail and a sidewalk would provide traction

Remarkable Sun-Dial as Accurate as a Watch

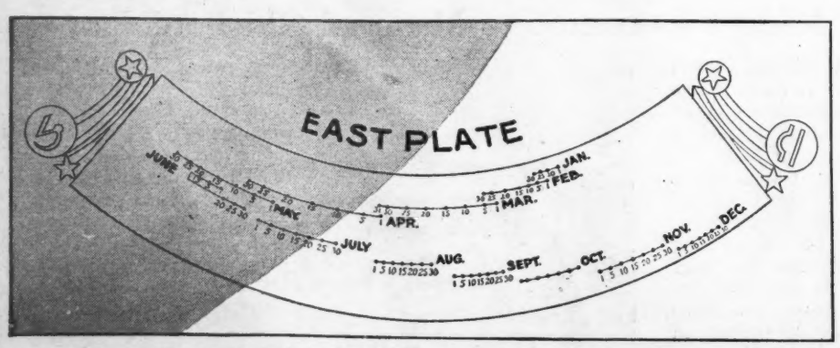
ONE of the most unusual sun-dials in existence is that at Columbia University, New York City, presented recently by the class of 1885. A 15-ton granite sphere casts a shadow upon the base so that the east and west edges of the shadow exactly pass through two marked points at high noon on any day of the year.

Two bronze plates east and west of the great ball are marked with a series of lines and points. Thus, for the tenth of April, at noon, standard time, the shadow crosses the April lines on the two plates at points marked 10.

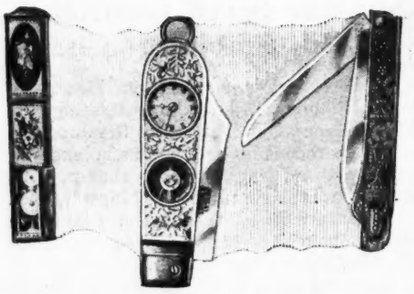
If the shadows are observed simultaneously, the moment the shadow lies as above stated is high noon.

At least two months will be indicated by the shadow on each plate, but only one month by both.

The calculation of these dial plates required months of work, first, because standard time was not the same as astronomical time, as determined when the sun reaches the zenith; secondly, because the base was a cone and the shadow a cylinder, making it necessary to compute the shadow line on the conical base.



Indicating noon, April 8 or July 22, determined by the shadow on the west plate



Tiny 18th Century Watches Rival Modern Handiwork

MODERN jewelers who have produced a "dime size" watch movement, small enough to be mounted on a finger-ring, point to the achievement as an example of the progress made in the watchmaker's art, but our illustration shows that small movements are nothing new.

The little timepieces in the handles of these jeweled knives were made in the eighteenth century, almost two hundred years ago. The production of such a small movement entirely by hand tools affords as fine an example of watchmaking as anything the present-day jeweler can offer.

Dr. W. D. Bates and his lie detector

Lies Read in the Eyes by Novel Detector

LIES, even those harmless lies that lubricate so many of Life's situations, promise to become hazardous luxuries if the "retinoscope," a lie-trap devised by Dr. W. D. Bates, noted New York City ophthalmologist, is vindicated by experience and comes into wider use.

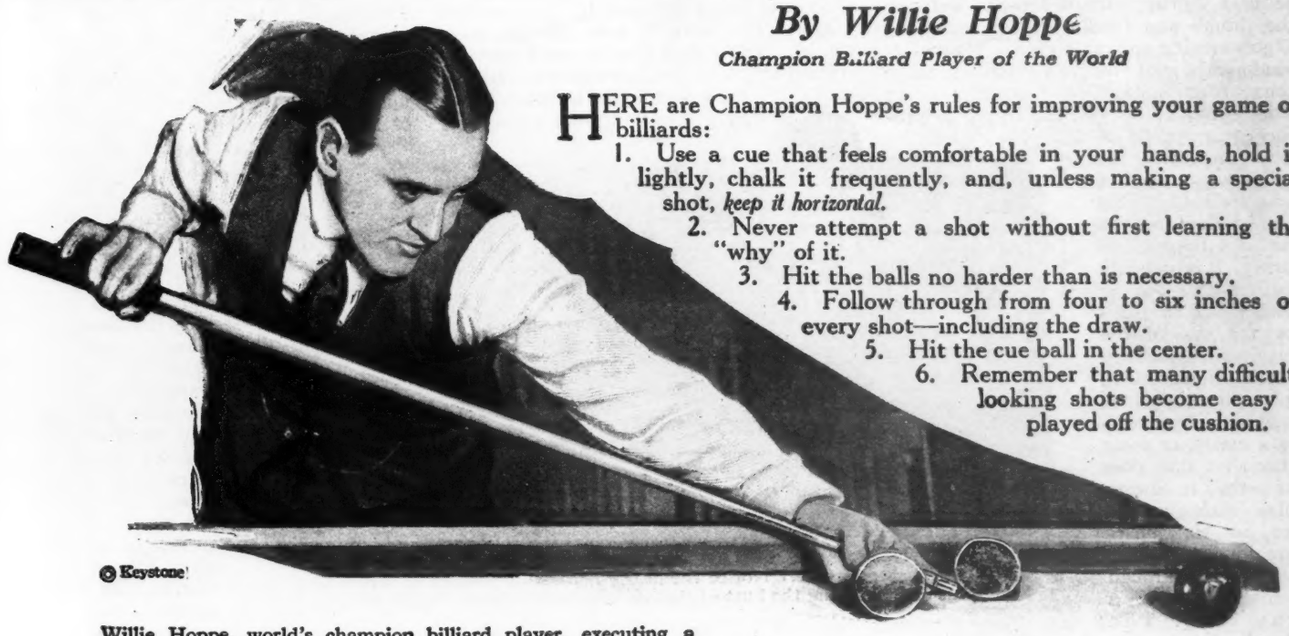
According to the inventor, prevarication produces a mental strain, a generally conceded contention. This, he says, results in a temporary nearsightedness. It is this effect which is detected with disconcerting accuracy, it is said, by the retinoscope.

The instrument reflects a bright light into a mirror. The suspect's eye is studied through it while he reiterates the doubted statement. If he is drawing upon imagination rather than memory, the shadow of the retina, according to Doctor Bates, moves in a direction opposite from that of the shifting mirror.

Mastering the Science of Billiards

By Willie Hoppe

Champion Billiard Player of the World



Willie Hoppe, world's champion billiard player, executing a typical draw shot. Notice how he holds his cue loosely between thumb and forefinger, using the remaining fingers as a guide

HERE are Champion Hoppe's rules for improving your game of billiards:

1. Use a cue that feels comfortable in your hands, hold it lightly, chalk it frequently, and, unless making a special shot, *keep it horizontal.*
2. Never attempt a shot without first learning the "why" of it.
3. Hit the balls no harder than is necessary.
4. Follow through from four to six inches on every shot—including the draw.
5. Hit the cue ball in the center.
6. Remember that many difficult-looking shots become easy if played off the cushion.

NO ONE would dream of plunging into deep water without first learning how to swim. Yet almost every day I see men attempting to play billiards—one of the most complicated and scientific games ever devised—with no knowledge of its fundamental principles beyond the fact that it consists of knocking three ivory balls around a felt-covered rectangular table with a tapering stick called a cue.

That may seem like an exaggeration, but I assure you it is not. Possibly 90 per cent of those who will tell you they "play billiards" have not the remotest conception of the definite scientific principles upon which the game is founded. Every billiard shot is a scientific problem, the solution of which requires practical knowledge of mathematical and mechanical truths and a fine adjustment of the player's mental and physical being. Although there are thousands who play *at* billiards all over the world every day, there are less than 10 who may be called first class players and certainly less than 100 who play the game well enough to turn in creditable scores day in and day out.

Of this little handful of expert players some of them, I feel sure, possess no better physical equipment for the game than those who must be classed as "dubs," but they have succeeded because they have learned to play the game with their brains—that is, scientifically. The average man who has enough interest in billiards to attempt to play the game occasionally, with a little thought and a little intelligent practice can bring about an almost magic improvement in the quality of his play.

The first and most important step to be taken in improving one's billiard game is a proper adjustment of the mental attitude—the psychology. Take the game seriously, and develop confidence in your ability to play it. The value of self confidence was brought home vividly to me early in my career as a professional player. On January 15, 1906, when I was 18 years old, I was playing Maurice Vignaux in Paris for the professional championship of the world. Although I had been playing in public for 11 or 12 years, I was nervous. It was my first championship match. Vignaux was a four to one favorite. When we began to play, however, my nervousness left me, for I concentrated on the game and tried to imagine I was merely practising on my own table at home. In France they divide a match into two periods. At the beginning of the second half it was anybody's game. In my first inning I found myself confronted by a ticklish shot. All the effect of the "self-kidding" I had been doing left me. Frankly, I was scared. If I should miss the shot, Vignaux would be left in excellent position to start a long run and win the match.

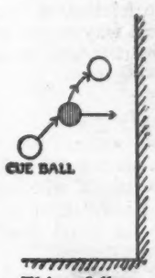
Right and wrong positions of cue in striking the ball for three of the most important and useful billiard shots

Should I try to make the shot, or should I miss purposely with the idea of leaving the French master out of position?

I hesitated before answering. Then I said to myself, "Willie, you're not going to get very far if you're going to be afraid to take chances. You've made harder shots than that a hundred times. Go to it!" So I chalked my cue, made the shot—and then ran 93, the longest run of the match.

That shot was the most important of my life—not because it virtually won the match and my first world's championship, but because it taught me something that every billiard player should know—never to attempt a shot unless you intend to make it count. Since that time I've been tempted to play safe many times, but I've never done it.

That, then, is the psychology of billiards. Now for the mathematics and mechanics.

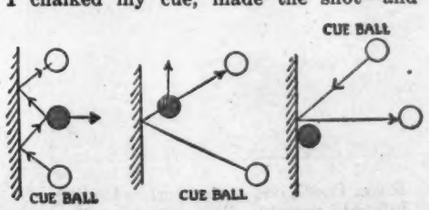


This follow shot Hoppe calls "my most important." By making it successfully, he won his first world's championship match

A correct cue is a most important element in developing mechanical efficiency in billiards. First of all, your cue should "fit" you. If it feels comfortable in your hands, it is the right one; if it does not, it is wrong. I use a cue weighing 19 ounces, but that is only because I have found that a 19-ounce cue is the proper one for me. Also, like most professionals, I use a cue with a comparatively hard tip. Although a hard tip gives less hold on the ball, it furnishes better "touch" and higher speed.

Most amateur players, I believe, would do better to use a soft tip in order to avoid miscues. A miscue in the last block of my match with "Young Jake" Schaefer in Chicago on March 29, 1922, probably prevented me from regaining from him the billiard championship of the world at that time. I was in excellent position with only 32 points to go when the miscue occurred. "Jake" immediately ran out the 10 points he needed and won the match.

Having found the cue that fits you, the



Three ways in which apparently difficult shots can be executed easily by hitting the cushion before striking either object ball

next thing is to learn to hold it properly. Don't grasp the butt with all your fingers as though it were an ax. This is a mistake made by most amateurs. The cue should be held lightly, almost loosely, between the thumb and forefinger, the remaining fingers serving only as a guide. No matter what sort of shot you are attempting, make your stroke smooth and steady—never jerky—and, unless you are trying to produce some special effect, keep the cue *horizontal. Do not raise the butt!* This causes the ball to spin and impairs accuracy. It is probably the cardinal sin of most unskilled players and one of the principal reasons why they remain unskilled.

Another important point — unless making a massé, or some other shot that does not permit it, always follow through from four to six inches after hitting the cue ball. Follow through even when making a draw shot. The "draw"—the backward motion that the cue ball takes after striking the object ball —is not produced, as many seem to think, by a quick, jerky, upward movement of the tip of the cue, but by the backward rotation which is given to the ball by striking it below its center. The steadier the stroke and the longer the follow through, the greater will be this rotation. Many players fail in attempting draw shots because they flinch, apparently fearing to give the ball a full forward stroke because they know they are trying to produce a backward motion.

Unless you have some good reason for doing otherwise, always strike the cue ball in the exact center, or just above it. This causes it to travel forward in a straight line and gradually to acquire rotation about a horizontal axis from the friction of the cloth. Stroking the ball that way causes it to go exactly where you want it, and in a straight line.

"Young Jake" Schaefer, ex-champion, from whom Willie Hoppe recently regained the world title. Notice the nearly horizontal position in which he holds his cue. Raising the butt of the cue impairs accuracy, Hoppe declares

Don't Hit Too Hard

Another warning—if you hit the cue ball harder than necessary, the result will be almost invariably a "bad leave," that is, the balls will be driven so far apart that your next shot will be a difficult one.

Don't be afraid to chalk your cue, and always chalk it when attempting a draw, follow, English or massé.

For practice in stroking I know of nothing better than driving a ball from one end of the table against the opposite cushion and holding the cue after the follow through to permit the ball to rebound against it. This, unless you are a player of some skill, you will find more difficult than it sounds, for, unless the ball is struck in the center, or exactly above it, a greater or less amount of English will be imparted and it will fail to return to the place from which stroked.

There are, of course, an infinite number of shots possible on a billiard table. To attempt to describe specific shots would be futile, but there are general principles involved in all shots which I shall try to describe briefly.

All billiard shots may be considered as belonging to the following classes or to a combination of them—the carom, the draw, the follow, the bank, and the massé. Carom is the word used to describe the rebounding of the cue ball from the object ball after striking it. It is probably the shot most frequently used by the inexpert player. The draw I have already mentioned. The follow shot is quite well described by its name. It is made by striking the cue ball above center, thereby giving it a great amount of forward rotation, which causes it to continue on its path after striking an object ball.

Bank, or cushion shots, are probably self explanatory and we shall make no distinction here between those in which the cue ball strikes a cushion before striking either object ball and those in which the cue ball strikes one object ball first, then the cushion, and then the second ball. The massé may be called exaggerated English. It is made with a nearly vertical cue against one side of the ball with aim taken almost through the center of the ball. In making it, the left hand may be held upright with the tips resting on the table, or the left forearm may be held rigid against the body and the cue directed against the ball through a loop-finger bridge.

In a massé, the cue ball describes a curved path, permitting the execution of direct caroms that otherwise would be impossible — when the three balls are in line, for example. In a short massé, little force is necessary, although the tip of the cue must "catch" the surface of the ball to give it the rotary motion that makes it curve.

Since the opportunity to score points by direct caroms is distinctly limited in a billiard game, the cushions must be used constantly to cause the cue ball to reach its objective. The angles at which the balls rebound from the cushions furnish the geometry of the game. In this connection, the first thing to be remembered is that when a ball is driven against a cushion without English, the angle of rebound is always equal to the angle of impact.

When it is necessary for the player to cause the cue ball to rebound from the cushion at a greater or less angle than that at which it is directed against it, he employs English. If the English is put on the side at which the ball would naturally rebound if it were not used, the angle of rebound will be lessened; that is, the ball will rebound more nearly parallel with the cushion. If the English is put on the other side, the angle of rebound will be larger; that is, the ball will rebound more nearly perpendicular to the cushion. When using English—unless attempting some other effect as well—hit the cue ball at half its height.

© Keystone

Roger Conti, one of the world's leading billiard experts, demonstrating the massé shot. Note how near the center his cue, held vertically, hits the ball

Practice Is the Best Teacher

I can't give any rules for determining the amount of English to be put on a ball. Nothing but practice will teach you that, and you can obtain the best practice, not by playing matches, but by setting the balls on the table and practising the same shot over and over again until you are able to execute it perfectly.

The average unskilled billiardist makes the game more difficult than it actually is by failing to learn the fundamentals before attempting to play. This means work. I am 35 years old and I have practised billiards not less than an hour a day since I was a boy of six. Also, when preparing for a match, I train—on the roads—almost as severely as a pugilist, for billiards is a trying game and good condition of the body and nerves is essential to success.

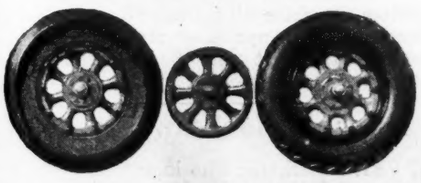
I do not expect any one who plays for amusement to tie himself down to any such rigid routine as mine, but I would advise him to take as much care with each shot as though a world's championship depended on it.

Midget Inboard Motor for Canoes

Smallest Full-Grown Horse in the World

THIS is Tiny Mite, the smallest full-grown horse in the world, 26 inches tall and weighing 51 pounds. His diminutive proportions are the more remarkable because he does not come of any diminutive breed of equines. He has as his sire and dam respectively, Baron B. and Lady Raffles, full-sized thoroughbreds and former race horses. Tiny's home is at Revere Beach, Mass., where his owner has erected a special miniature barn for him.

Solid or Pneumatic Tires Worn by New Wheel



A NEW wheel design for motor trucks permits the use of solid or pneumatic tires without changing the wheel. On the wheel in the center may be placed either the solid tire and wide rim shown at the left or the pneumatic tire and rim shown at the right.

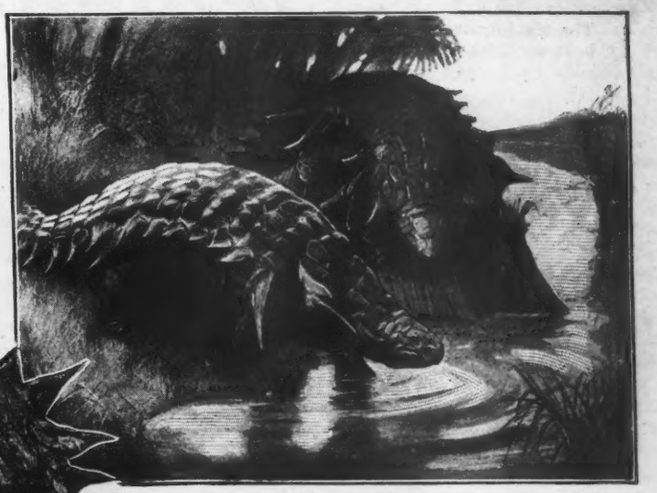
Tennis Balls Are Cleaned by Brushing Machine

DIRTY tennis balls, which grime the hands and white sport clothes, now can be banished inexpensively, it is claimed. But it is the condition and not the ball that really is banished.

Stains of grass or clay are said to be effectually removed by the recently patented brushing machine here shown. This device is screwed to the wall, or to some solid object convenient to the tennis court. The dirty balls are placed between the brushes through the swinging gate, which is shown open in the illustration.

Two balls can be cleaned at once, their separation being accomplished by a curved arm. When the handle is turned, the brushes revolve, reaching every portion of the balls' surfaces and causing them to leave the machine looking very much like new.

Armored Monster Once Roamed Texas



Palaescincus, or "armored dinosaur," as it probably appeared when it roamed the Texas plains ages ago: a restoration from fossilized skeleton (below) found in Texas

MANY thousand years ago this formidable looking creature roamed the plains of Texas. Perhaps it was the original Texas steer. This striking animal is Palaescincus, the "armored dinosaur," a restoration of whose skeleton has just been placed in the American Museum of Natural History, New York City.

The scientists who exhumed the fossilized remains and made the restoration, say that, despite its forbidding appearance, the beast was really a gentle and peaceful creature that lived on grass. Its spiny armor, it seems, was utilized only as protection.

The creature stood about five feet tall, measured approximately 20 feet from nose to tail, and was about as easy to damage as an armored tank.

World's Champion Hen Has Laid 1300 Eggs

ABOVE is Mrs. Lyle Funk, of Shirley, Ill., holding her prize white Leghorn hen, Lady Anne, said to be the champion egg producer of the world. Lady Anne is 10 years old, and in the nine years that elapsed since she learned to lay has produced more than 1300 eggs, with a total weight of about 175 pounds.

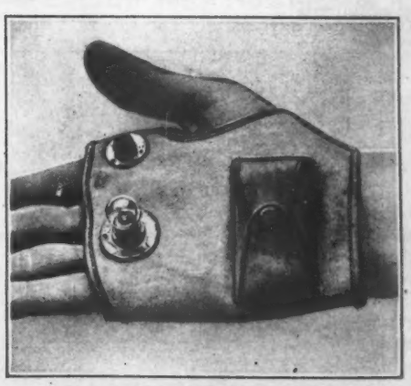
The poultry books say that the world's record for egg production is 1355, held by a hen which has long since passed on. Lady Anne's owner expects her to exceed this record by a wide margin, since she is still a steady producer, and so healthy that any actuary would give her several more years to live.

Burglar Carries Lamp in Palm of His Glove

A SAFE-CRACKER'S ingenious lamp attached to the palm of a glove recently was seized by Detective Captain Sam Street, of San Antonio, Tex.

In the palm of the glove is a pocket, in which is placed a small electric battery. Flat wires lead the current through the switch at the base of the index finger to a bulb at the base of the third finger.

This arrangement enables the burglar to press the switch button with his index finger while shielding the light so that it will not be visible from behind. A sufficient amount of light is projected forward to enable him to read the combination on the safe he is about to rob.

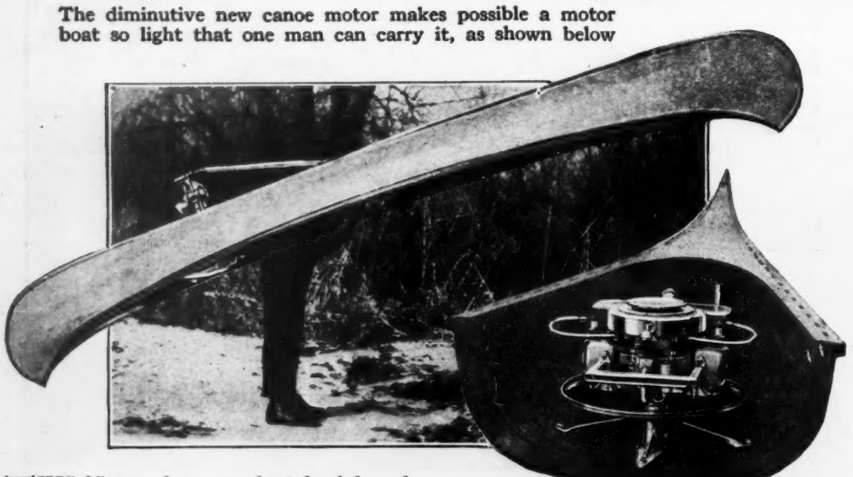


Lamp and switch button in glove

WITH British and French engineers completing plans for a 31-mile traffic tube under the English Channel, a transportation dream 120 years old now seems likely to be fulfilled. This gigantic project to connect Dover and Calais by the world's greatest tunnel will be described with fascinating and authoritative illustrations in an early issue of Popular Science Monthly.

Midget Inboard Motor for Canoes

The diminutive new canoe motor makes possible a motor boat so light that one man can carry it, as shown below



Above, the inboard installation

THIS 35-pound power plant for inboard installation in canoes marks the achievement of the long desired portable motor boat, permitting one man to take long, solitary canoe voyages through such districts as the Canadian lake country, which require frequent portaging.

The motor is constructed so that it lies low in the canoe, thus greatly increasing the stability of the craft. It can be installed in from two to three hours and removed in 10 minutes. A heavy, diagonal skeg from the tip of the projecting motor parts protects the propeller blades.

A Pocket Check Protector

PERFORATIONS to prevent the altering of checks, long used by business houses, are made available for personal checks by this new, pocket-size perforator.

The perforator is of silver plates, between which the check is placed and

punched. These perforations, opposite printed numerals on the margin of the check, designate the maximum amount.

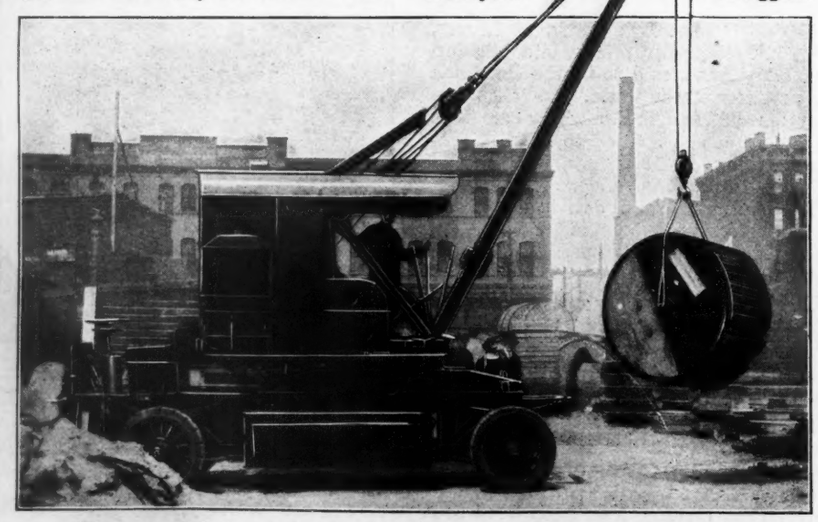
Crane and Truck Combined in Mobile Lifting Unit

THE mounting of a lifting crane on a storage battery electric truck was accomplished successfully for the first time recently by the New York Edison Company.

Since being placed on the truck, one of five tons, the crane has shown a lifting capacity at least 40 per cent greater than that at which it was rated by the manufacturer. This remarkably efficient performance results from the lowering of the crane's center of gravity by the weight of the storage battery.

The crane has been used successfully in such work as handling heavy reels of cable, loading coke and coal and piling manholes and castings. The device can pick up a large reel of cable and place it on a truck in from 30 seconds to 1½ minutes. The only methods practicable before its development required from 10 to 20 minutes for the same work, moving loads in smaller quantities and far more slowly.

The ordinary type of crane cannot be moved from place to place over city streets. The mobility of this new crane makes that easily possible. Hence it becomes available for making lifts for such work as is usually left to riggers.



The powerful electric truck and crane hoisting a large spool of cable

Upright Camp Fire Broiler for Outdoor Cooks

A NOVEL outdoor broiler that stands erect beside the fire has been invented for campers and picnickers. It is supported at the back by a sharp-pointed wire leg that is pushed into the sand or dirt.

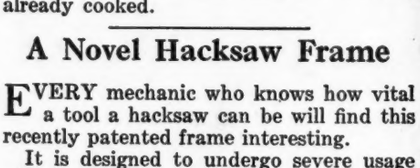
The invention really is a wire inclosed in a cooking pan. The flavor of food broiled over a camp fire frequently is spoiled by smoke—a disagreeable feature of camping that is prevented by the new device. Meat can be turned in it without being disturbed, and a fish being grilled will not be broken into unappetizing scraps.

The pan is fitted with a trough at the bottom, in which all juices and grease are caught. This pan also serves to concentrate the heat and keep hot the side already cooked.

A Novel Hacksaw Frame

EVERY mechanic who knows how vital a tool a hacksaw can be will find this recently patented frame interesting.

It is designed to undergo severe usage without springing. In designing the handle,



the inventor remembered the mechanic's comfort and shaped it to his hand. The frame is equipped with devices that allow the blades to be released and tightened quickly, and different sized blades to be adjusted easily. Quick setting of the blades to cut four different ways is also easy.

Filling Station for Pens

FOUNTAIN-PEN filling stations in office buildings, schools, and libraries are interesting possibilities of tomorrow.

The "station" pictured here has been operated successfully for months at the University of Chicago.

A penny dropped in the slot releases enough ink to fill an ordinary fountain pen. You may first drain your pen in the left-hand container and a penwiper may be pulled from the upper right corner.

the scourge was rampant, he consented to visit the afflicted area and study the disease on the spot. It required six years of

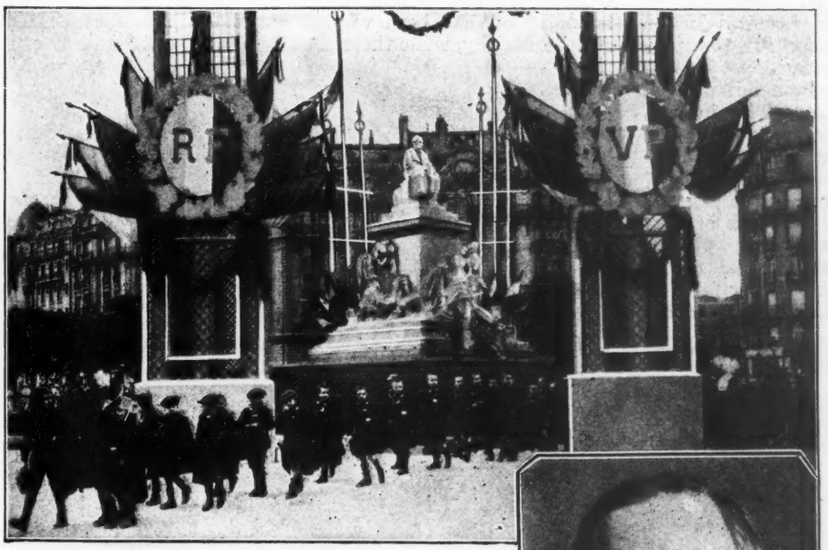
greeted with derision by scientists, veterinarians, and cattle raisers.

Working constantly with dogs suffering from a disease that made their bite fatal

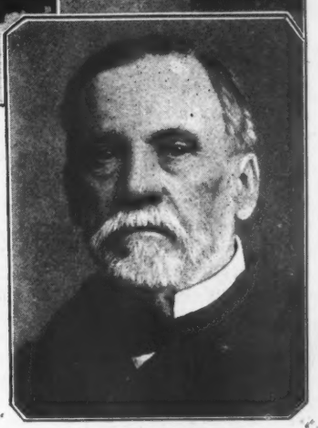
He Saved a Million Lives

The Inspiring Story of Pasteur, Great French Conqueror of Disease, Whose Centenary the World Celebrates

By R. E. Martin



Orphan children marching before the statue of Louis Pasteur in Paris, celebrating the centenary of the great French scientist who has been called "the supreme benefactor of the human race"



Louis Pasteur

THIS year the whole world is celebrating the centenary of Louis Pasteur, the great scientist, who, in point of alleviating suffering, has been called "the supreme benefactor of the human race."

France, the country of his birth, set aside six months in which to honor his memory by a series of fêtes and exhibits, one of which delegates from every country attended. In the United States the centenary is being observed generally by scientific societies and by the scientific departments of colleges and schools.

To the layman the name of Pasteur probably brings to mind only two great scientific achievements—the Pasteur treatment for hydrophobia and the heating process, known as pasteurization, by which milk is made germ-free and suitable for human consumption. These, tremendously important though they are, may be considered as only two incidents or phases of Pasteur's far reaching life work.

He it was who blazed the trail for modern antiseptic surgery. He it was who first developed the principles by which the medical profession now controls infectious and communicable diseases. By his researches he proved that the virulent plagues from which mankind had suffered for centuries were caused by living microorganisms—germs. And he was the first scientist to learn that these germs could be cultivated by man and injected into the bodies of sufferers to fight the very germs that caused disease.

He pointed the way to the present-day control of such frightful scourges as hydrophobia, tuberculosis, malaria, tetanus, infantile paralysis, leprosy, syphilis, dysentery, diphtheria, smallpox. And thus he saved at least a million lives.

He saved the herds of France from extermination by anthrax, and taught the world his methods so that they might be applied to cattle everywhere.

He saved the silk industry of France by finding the cause and the cure of a disease that was killing the silkworms.

He discovered that living microbes caused the fermentation of wine, beer, milk, and butter, and he taught the wine-makers of France how to grow their grapes so that poisonous fermentations could not develop.

Although he was neither physician nor biologist, it is to him that both these sciences owe probably their largest debts.

The amazing feature of Pasteur's life is that his most important work was done after the age of 46, after he had suffered a stroke of paralysis that made him virtually a cripple for the rest of his life.

By training and profession Pasteur was a chemist. He was born at Dôle, the son of a tanner.

As a boy, and even as a college student, this great man showed no extraordinary qualities. In fact, his college diploma stated that he was only "average" in chemistry.

It was in 1854, when he was professor of chemistry at the college at Lille, that a distiller sought his aid in discovering the cause of certain harmful fermentations in wine and beer. This incident may be said to have furnished the groundwork for all of Pasteur's later scientific achievements; for, while studying with crude apparatus the beverages he had been asked to test, he discovered living minute bodies, which developed only when the liquids were exposed to air.

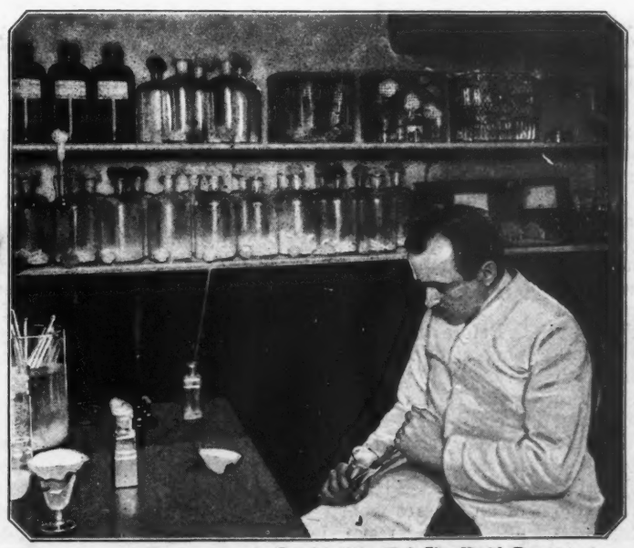
Up to that time the phenomenon of fermentation had been shrouded in mystery, although scientists of the day had offered dozens of ingenious theories regarding its cause. Pasteur proved absolutely that it was due to germs. He proved then that fermentation did not occur when the air was excluded. He followed up these discoveries by demonstrating in a series of intricate experiments that the germs were not generated spontaneously in the fermenting beverages, but existed in the air.

Not only did his findings teach the vintagers and brewers how to save their products, but when applied to surgery as antisepsis, they have taught the medical profession how to save human life.

Before Pasteur the percentage of deaths from infection after surgical operations had been as high as ninety. Now the most dangerous and complex operations are boldly performed without fear of infection.

It was Pasteur who first taught the doctors to sterilize their instruments by passing them through a living flame. Through his discoveries of the nature and sources of germs was developed the complete sterilization of surgical instruments and dressings as practised in the modern hospital.

In 1865 the French silk industry had reached the verge of ruin through a fatal sickness that had attacked the worms. Up to that time Pasteur never had seen a silkworm, but, at the solicitation of a friend who lived in the south of France, where



Courtesy New York City Health Department

Grinding serum for the Pasteur treatment of hydrophobia, or rabies, in the laboratory of the New York City Health Department. The serum, extracted from the spinal fluid of animals, is converted into liquid form for human injection

Young Inventor Aids Uncle Sam

the scourge was rampant, he consented to visit the afflicted area and study the disease on the spot. It required six years of patient, discouraging work to trace the mysterious disease to its cause, and to find a cure, but Pasteur at last succeeded, and the silk industry was saved. It was while at work on the disease of silkworms that Pasteur suffered the paralysis that left its mark on him through life.

Pasteur's work in every case was done in some field of practical usefulness, to supply some economic or human need; yet Pasteur continuously looked up from this work of the moment into the future. Thus in 1879, long before he had attempted to turn germs of disease into a vaccine which would destroy disease, he wrote:

"Must we not believe that the day will come when preventive measures of easy application will arrest human plagues which at one blow desolate and terrify whole populations, as did yellow fever in its recent invasion of the Senegal and the valley of the Mississippi, or the bubonic plague that has raged on the Volga?"

Saving Cattle

This question he asked in commenting on his work in checking the ravages of anthrax, which two years before had attacked the sheep, cattle, and pigs of France. It was in fighting this plague that Pasteur first was successful in utilizing a germ culture as a vaccine. This achievement science places in the forefront of his discoveries, for the only diseases which today baffle medicine are those of which the germ has not yet been found. Walking one day through a recently harvested field, Pasteur was struck by a peculiar red formation in the soil at certain spots. Investigating, he found that the color was due to cylinders of earth left by worms. Upon making inquiries in the vicinity he learned that the carcasses of animals which had died of anthrax had been buried there.

Instantly there occurred to his mind the possibility that the worms were spreading the anthrax plague. Examination of the worms disclosed the presence in them of a germ similar to a germ development found to exist in the blood of animals killed by anthrax. From the blood specimens Pasteur produced germ cultures with which he inoculated healthy animals. The animals so injected developed anthrax and the bacilli of anthrax were found in their blood.

Further experiments disclosed that the germ cultures, if subjected to heat, became weakened in their disease-producing qualities. This fact Pasteur interpreted to mean that in the germs of arrested growth the former virus had become a vaccine. Experiment substantiated his theory, and he announced his discovery, only to be greeted with derision by scientists, veterinarians, and cattle raisers.

Pasteur, certain of his ground, agreed to subject his theory to a public test, which was arranged at Melun. A herd of 25 healthy sheep was injected with the vaccine. Then these and 25 other sheep which had not been vaccinated were inoculated with anthrax. Pasteur predicted confidently that within five days the animals that had been vaccinated would still be healthy, while those that had not received the vaccine would be dead. What he predicted came to pass. Scientists who had scoffed now applauded. Science accepted his discovery. His vaccine was put into use and the herds of France were saved.

At the right, a highly magnified view of milk that has been soured by millions of bacteria. In milk held at a temperature of 68° F., bacteria multiply more than 4000 times every 24 hours

Courtesy Borden's Farm Products Co., Inc.

Pasteurizing milk in a large dairy plant. Disease bacteria are destroyed by Pasteur's scientific process of heating and cooling the milk. Pasteurizers and milk holding tanks are shown in the gallery. In the coils at the left the milk is cooled after it is taken from the tanks where the bacteria are destroyed

Pasteur Develops Rabies Vaccine

Before the days of Pasteur, hydrophobia, or rabies, always was fatal. Of every 100 persons bitten by rabid animals, 16 developed the disease and all of them died. Studying the disease in dogs, Pasteur reached the conclusion that it had its seat in the nerve centers—an opinion substantiated by the fact that an injection of an extract from the spinal fluid of an affected dog resulted in the development of rabies by a healthy dog.

What Pasteur had done with the virus of anthrax he attempted to do with the virus of rabies. He developed a weakened culture which would constitute a vaccine. Working constantly with dogs suffering from a disease that made their bite fatal was perilous work, but Pasteur never shrank from it. He developed his vaccine, and injected it into animals that had been bitten by rabid dogs. Invariably the animals recovered. Although these results pointed to success, Pasteur feared to use his vaccine on human beings.

On July 6, 1885, however, there appeared at his laboratory Joseph Meister, an Alsatian boy of nine, who had been bitten terribly by a mad dog. The boy's frightened mother begged Pasteur to attempt to save her son's life, and at last he consented.

Sleepless nights, the anguish of fear and constant watchfulness at the bedside were Pasteur's portion until the boy's recovery testified that once again he had prevailed over death itself. Three years later the Pasteur Institute was opened in Paris, and today there is not a country in the civilized world that does not support at least one similar institution. Thousands of people have been treated at these institutes. Through the treatment discovered by Pasteur, the death rate from this most terrible disease is reduced to less than one per cent.

Priceless Work

Of the money value of Pasteur's discoveries much has been said. His methods of curing anthrax, chicken cholera, and the disease of the silkworm saved France, so his contemporaries asserted, more than the whole cost of the war indemnity paid by France to Germany in 1870. His work in the saving of human life is priceless. In the last half century the average span of life has increased 15 years, the infant mortality rate has been reduced one third, and the deaths from typhoid have been reduced four fifths. In no small measure are these improvements in public health the direct result of Pasteur's labors. Certainly his discovery of a cure for puerperal fever has saved the lives of thousands of mothers. Certainly the light he has cast on the field of preventive medicine and his development of vaccines led directly to the control of such diseases as typhoid.

Pasteur lived to enjoy in full measure the fame and honors that his work had earned. Long before his death—Sept. 28, 1895—the whole scientific world had been at his feet. Many monuments have been reared to him, but none will prove more lasting than humanity's grateful memory of the victorious fight he waged for all creatures against the hosts of death.

Young Inventor Aids Uncle Sam

How 18-Year-Old Postal Employee Ingeniously Doubled His Output

By H. H. Billany
Assistant U. S. Postmaster-General

NO BRANCH of the government service is more ready—I might say more anxious—to reward employees who evidence originality and ingenuity in the performance of their duties than the Post Office Department. Particularly is this so with regard to employees who suggest or develop improvements in mail-carrying equipment or in the machinery of the shops where the mail equipment is manufactured.

An interesting instance of this policy of the Post Office Department is furnished by a recent case in the mail equipment shops in Washington, D. C.

Antonio J. Lombardi, an 18-year-old employee of the mailbag repair department, for some time had been turning in time sheets that indicated he was performing about twice as much work as any other man in the shops ever had been able to do. Lombardi's particular job was the reaming of keyholes for mailbags.

Greenhorn Mystifies Experienced Men

His superiors in the shops could not understand how he, with only a few months' experience, could turn out more work than men who had been in the service for years. They began a quiet investigation. Experienced workmen, when questioned, asserted that it was impossible for one man to produce as much work as Lombardi claimed he was doing. They even suggested that there could be but one explanation—that his time slips had been padded.

Reluctant as they were to believe this, and failing to see what permanent benefit young Lombardi might derive from falsifying his records, the shop officials called the lad before them and bade him explain. Lombardi was embarrassed, but insisted stoutly that his time slips were entirely accurate. Pressed for further explanation, he at last led his questioners to his locker and drew from it a small block of wood on one side of which was carved a small half cylinder. This contrivance, he declared, was the secret of the unbelievable amount of work he had been turning out.

When the shop officials expressed their incredulity, Lombardi escorted them to his machine

Antonio J. Lombardi, 18-year-old post-office employee, who doubled his output in reaming keyholes for mailbag locks by inventing the simple block shown in inset, and so won official recognition

and inserted the block beneath the drill. The half-cylinder in the block fitted the curved end of the mailbag locks, permitting him to insert the lock with his left hand and work the reaming machine with his right simultaneously, instead of using both hands to perform each operation as other operators on the machines were compelled to do.

Lombardi explained that he had been accustomed to use the block at his work when he was unobserved. He hid it away in his locker at night, he said, fearing the shop managers might reprimand him for making unauthorized improvements on government machines. When he had explained, he seemed to fear that he would be discharged for what he had done.

Instead, a report regarding Lombardi's device was forwarded to Postmaster-General New, who investigated its merits and ordered that a cash award be made to the lad for his invention and that he be given a certificate setting forth the reason for his reward.

And now Lombardi's device has been adopted by order of the Postmaster-General as standard equipment.

What a Small Invention Did for Me

Prize Contest Announcement

READ Mr. Billany's inspiring story above. An ingenious idea won recognition from the postal authorities for young Lombardi. Perhaps you have had some similar experience. Possibly some simple device you have invented has helped you in your work, has won promotion for you. Tell us about it. Your letter should be based on personal experience. Remember that a simple story is likely to be the best.

For the best letter of not more than 400 words we offer these prizes: $20, first prize; $10, second prize; $5, third prize.

Address letters to Invention Contest Editor, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York City. Each letter will be considered by a board of editors, whose decision will be final. The competition closes October 20, 1923. Winning letters will be published in the February, 1924, issue. Contributions to the contest will not be returned unless accompanied by a stamped, self-addressed envelope.

Combination Wrench Has Wide Range of Uses

A TOOL with an unusually wide range of usefulness is the combination pliers, monkey-wrench and pipe wrench illustrated here. It is quickly adjusted to fit various sized pipes, bolts, nuts, caps, nipples, and similar parts. It has a capacity for parts up to one inch square and 1⅛ inches round.

The tool is seven inches long, weighs about 12 ounces, and is made from a drop forging, machined, heat-treated and given a charcoal and gun finish.

Used as pipe wrench

With Webbed Gloves, Bathers Swim like Ducks

BATHERS who claim to be able to swim like ducks now can make good their boast by equipping themselves, not with webbed feet, but with webbed hands.

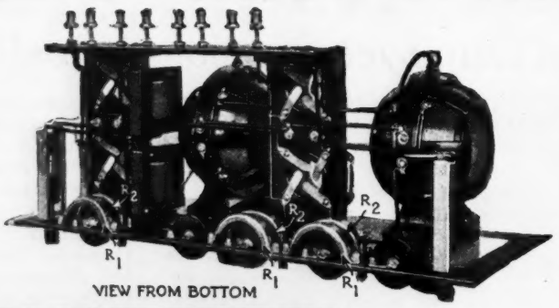
The webbed rubber gloves shown below do the trick. Swimmers who have tried them say that they make the process of moving through the water almost as easy as walking. Since the webbing displaces more water than the bare hands, greater speed is obtained. The gloves also protect hands from being shriveled by water.

These gloves displace more water than bare hands and increase swimmer's speed

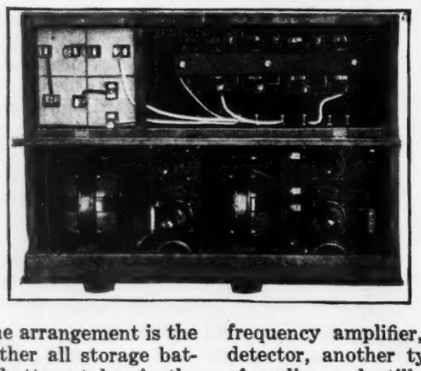
You Can Use Any Tube in This Set

TWO novel circuit arrangements are the features of the latest type of radio set, designed exclusively for the reception of broadcasted programs.

Two rheostats, one of the high resistance type and the other of the low resistance type, are used with each tube socket. By means of small pushbutton switches, either rheostat can be connected into the circuit of each tube socket. So, using adapters in the standard sockets provided with the set, the filament current requirements of any standard storage or dry battery tube can be met by connecting one or the other rheostat in the filament circuit tube.



VIEW FROM BOTTOM



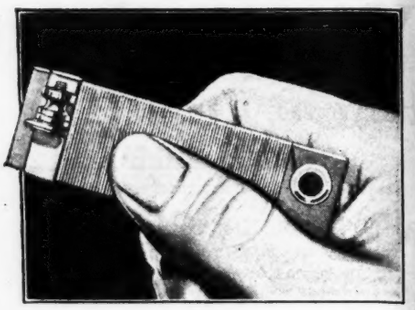
Arrangement of the new circuit viewed from the top (at left) and from the bottom (above), using tuned radio frequency and regeneration. R_1 and R_2 are 6- and 30-ohm rheostats respectively

One advantage of the arrangement is the possibility of using either all storage battery tubes or all dry battery tubes in the set, depending on whether it is to be used as a portable outfit or as a home receiver. It is possible also to use different tubes in the different stages of the set.

It is well known that some tubes are better than others for radio frequency amplifiers, while other types are better fitted for use as detector tubes, first stage audio or second stage audio amplifier tubes. With the new circuit arrangement one type of tube can be used for the radio frequency amplifier, another type as the detector, another type for the first stage of audio, and still another type for the second stage. In addition, all tubes of one kind can be used, if desired.

The novelty of the actual wiring in this set lies in the manner in which tuned radio frequency plus regeneration is accomplished.

While there are several adjusting controls, there is only one adjustment that is critical, so the set can be considered a one-control set. It can be operated without an aerial, but it gives better results when a good indoor or outdoor aerial is used.



This New Resistance Unit Is for "Peanut" Tubes

WHEN operating the new dry cell tube that consumes .06 amperes, it is necessary to use a larger resistance than the regular rheostat in order properly to cut down the voltage of the three dry cells used in series to provide the proper operating current. For this purpose the resistance unit pictured above recently has been put on the market by a rheostat manufacturer.

By placing it in series with the regular rheostat and filament, the resistance of the circuit can be varied.

This unit also will find numerous applications in the experimental laboratory.

Radio Panels from Records

DANCE records of yesteryear that clutter your cabinet need not be thrown away if you are a radio enthusiast. They make excellent radio panels, being of excellent insulating material and easily drilled.

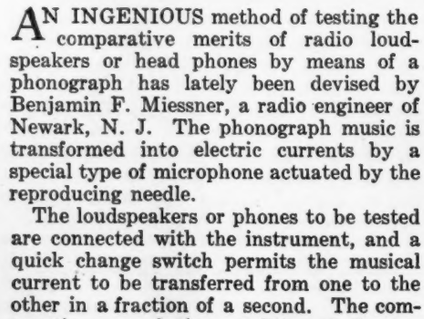
The illustration shows two sets thus fashioned from discarded records. The top view of the panel, at the left, shows the switch points for tuning, the detector and binding posts for phones and the aerial and ground. The bottom view shows the tuning coil and the variable condensers. The completed set is mounted on a round cardboard hatbox, a neat crystal set.

Loudspeakers and Phones Tested by Phonograph

AN INGENIOUS method of testing the comparative merits of radio loudspeakers or head phones by means of a phonograph has lately been devised by Benjamin F. Miessner, a radio engineer of Newark, N. J. The phonograph music is transformed into electric currents by a special type of microphone actuated by the reproducing needle.

The loudspeakers or phones to be tested are connected with the instrument, and a quick change switch permits the musical current to be transferred from one to the other in a fraction of a second. The comparative reproducing qualities of the apparatus under test are apparent instantly. The test is said to be more satisfactory than ones conducted with a radio receiver, because the volume and quality of phonograph music is constant, whereas radio signals may vary continually.

The device has been made portable.



Radio for the Steeplejack

RADIO enthusiasts seem to be wherever there is air and a place to stand or sit. This picture shows how radio followed Michael Bourke, steeplejack carpenter, to dizzy heights in order that his noonday meal might be spiced with melody.

Radio to Join Ford Holdings

THE vast property holdings of Henry Ford, scattered throughout the world, are to be unified by radio. A large broadcasting station, strong enough to communicate across the Atlantic, is being constructed at the River Rouge Ford plant. This latest step results from the successful operation during the past eighteen months of radio and wireless communication between Ford plants throughout the United States and Ford headquarters in Dearborn and Detroit.

satisfactory, because what we really do with such a system is to tune each of the from any station. To accomplish this, the dials must be fitted carefully to the shafts, equal forces neutralize each other. Now the regenerative action in a radio amplifier

Around the Radio Circuits

with Jack Binns

Third Article: Tuned Radio Frequency and Neutrodyne

This is the last of a series of three articles in which Jack Binns, our radio editor, reduces apparently intricate radio circuits to first principles

SOMETHING about the name, "Tuned Radio Amplification," gives it an air of mystery. To the average fan the name conjures up visions of controls and adjustments that only the expert can master.

To many who have dabbled with the ordinary form of transformer coupled radio frequency amplification, there seems to be no justification for "tuned radio." They cannot see why any one should add adjustable circuits where a fixed circuit apparently will work with supreme satisfaction.

Simplifying "Tuned Radio"

To clear up this question, and to show that "tuned radio" is by no means as complicated as it seems is my purpose in this article, the third of a series designed to explain various types of circuits by tracing their evolution from the original basic hook-up.

Of course, it is an easy matter to say that a thing is not difficult, but it is quite another matter to prove that assertion. In this case I shall attempt to prove my contention first by considering the very simplest circuit as a means of illustration.

If we place a variometer in series with an aerial and ground, then place a crystal detector and a pair of telephones across it, we shall have a complete radio receiving set that will work over a distance of at least 25 miles.

Let us analyze this circuit and its operation. When we turn the rotor coil of the variometer to a certain position, we hear the speech or music that is coming from the nearest broadcasting station.

Naturally the wave-length range of such a receiver is extremely limited, and will be determined by the maximum and minimum inductance represented by the range of settings on the variometer.

How does such an instrument, so very simple in itself, work satisfactorily? When we have clearly understood this, we shall be able to comprehend the action that takes place in "tuned radio."

In the first place, the electromagnetic waves that surge through the ether from the aerials of the broadcasting station consist of an alternating current wave with a tremendous high frequency. In other words, electricity is passing through the cycle, negative to positive, and back to negative again at a rate of about a million times a second.

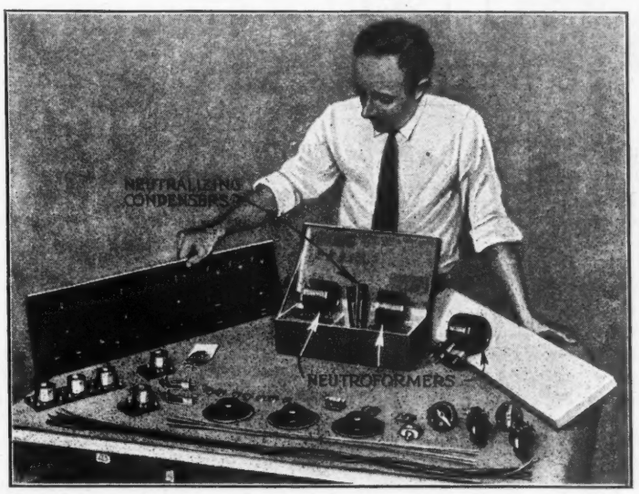
This terrific rate of change is referred to as "radio frequency" because it is far above the range of variation that comes within the audible scale. A wave that is alternating at such high frequency introduces the phenomenon of electrical resonance, and in order to record it we must have a circuit that is capable of resonance.

The primary requirements of such a circuit are inductance and capacity. The former is obtained by means of a coil of wire, the latter by means of a condenser.

The remarkable thing about the circuit is that there must be a certain balance between capacity and inductance for every wave length—in other words, for every frequency. All such circuits that combine inductance and capacity are called "oscillatory circuits."

"That is all very well," you may say; "but where do you get the capacity with only a variometer?"

The answer lies in the fact that in every piece of wire there is a quality known as "distributed capacity." If we wind this wire in the form of a coil, and put insulation around the wire, we shall find an appreciable amount of capacity in the circuit represented by the winding.



Complete outfit of parts for building a radio receiver using Prof. Louis A. Hazeltine's neutrodyne circuit, shown in diagrams on page 62. Because of the difficulty of winding the three neutroformer coils properly and of making the small neutralizing condensers, manufacturers now are building these parts complete for amateurs who like to make their own sets

Variometer Will Help

In this case we obtain our tuning by varying the amount of inductance in the circuit, without interfering with the total capacity of it. Such a method of tuning is practical and efficient. Under such circumstances a variometer is a very efficient tuning instrument, provided too much is not expected from it.

After we have grasped the underlying principles in the action of an oscillatory circuit, we can proceed to an explanation of the difference between transformer coupled radio amplification, and "tuned" radio amplification.

If we impress an alternating voltage across the grid and filament of a hard vacuum tube, an equivalent of the voltage will be reproduced in the plate circuit, provided the right constants exist in the plate circuit. There will be this difference, however—the reproduction in the plate circuit will be many times stronger because of the amplifying characteristics of the tube itself.

Radio frequency transformers are designed to pass this amplified current along to the next tube for further amplification. In the very nature of things these transformers are designed to cover a fairly large wave-length band. In other words, they must cover a wide range of frequencies, otherwise separate transformers would have to be inserted in the circuit for each individual broadcasting station.

This being the case, the transformer will be more efficient on the frequency to which it is nearest in resonance than it will on any of the other frequencies it passes. This is a disadvantage that in practice is offset by the fact that the transformers are automatic in their action, and do not require adjustment.

It is in this respect that "tuned" radio amplification is really the most

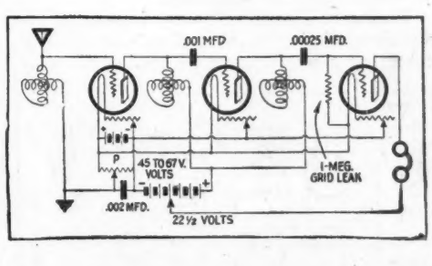
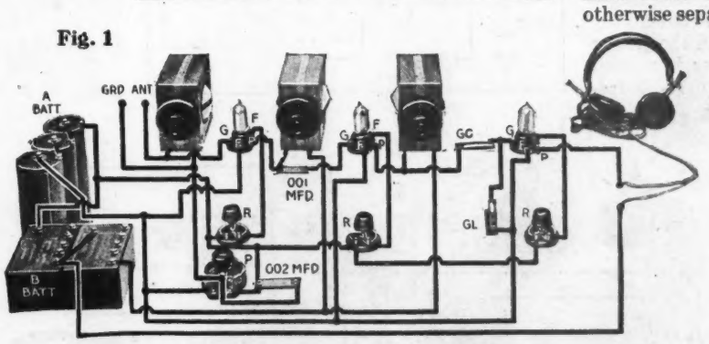


Fig. 1



Tuned radio frequency circuit: *R* signifies rheostat; *P*, potentiometer; *GC*, grid condenser, .00025 mfd.; *GL* grid leak, 1 or 2 megohms. Ccmplete constructional details of a tuned radio frequency unit that can be used with any standard set will be given in next month's Home Workshop Department

Largest Cut Stone Columns of Modern Times

satisfactory, because what we really do with such a system is to tune each of the circuits into resonance with the wave we are receiving. The result is that we obtain the maximum possible amount of amplification, the maximum transfer of energy from one stage to another, and the maximum amount of selectivity.

The ability to obtain maximum selectivity is apparent. Each stage acts as a sieve, allowing only those currents that are in exact resonance to pass through, and stopping the others. The drawback, of course, lies in the increased number of adjustments necessary.

Now, if we examine various diagrams of simple receivers, we shall observe that in addition to the variometer circuit described in the beginning of this article, we can have a double circuit that can be quite an elaborate affair. For example, it can consist of a variocoupler with a variable condenser in series with its primary winding, and another condenser across its rotor winding. Under these conditions it will have four different tuning elements: First, the setting of the series condenser; second, the number of turns of wire put in use in the primary; third, the degree of coupling between the two coils; and, fourth, the setting of the second condenser.

Similarly the interstage coupling of a radio frequency amplifier can be made simple or complicated, as desired. The more adjustments used, the more accurate will be the resulting tuning, and the more expert will be the handling required. In practice, a multiplicity of adjustment is not necessary. In fact, a variometer in each of the circuits will be sufficient, provided the variometers are designed to cover the wave length band to be received.

Difference Lies in Grid Circuit

Such is the basic system of "tuned" radio amplification, a circuit diagram of which is shown in Fig. 1, on page 61. A glance at the diagram reveals that for all practical purposes the method of coupling the different stages is almost the same as that employed in audio frequency amplifiers.

The main difference lies in the grid circuit when a plain variometer is used. In this case the B battery is joined to one side of the variometer. We could not connect it direct with the grid, for if we did so, we should be impressing the full B battery voltage across the grid and filament of the succeeding tube, preventing operation.

This difficulty is overcome by inserting a by-pass condenser in series between the plate side of the variometer and the grid of the next tube. This condenser is a fixed one, and will readily pass the radio frequency currents in the circuit, at the same time effectively stopping the direct current of the B battery from reaching the grid circuit.

If more than one stage of "tuned" radio is employed, and the variometer type of coupling used, it will be found that every variometer actually in a plate circuit can be calibrated for wave length, and settings made accordingly for reception from any station. To accomplish this, the dials must be fitted carefully to the shafts, so that relative positions of the dial and rotor will remain unchanged.

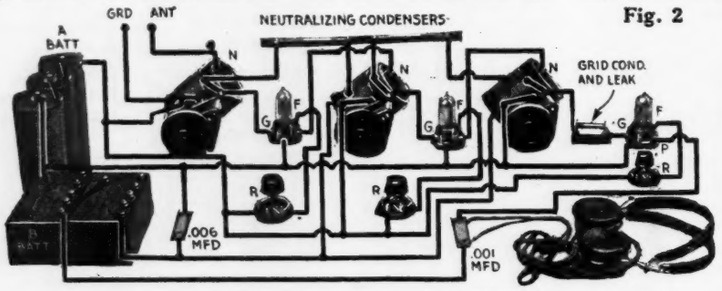
Under these circumstances, tuning can be accomplished in the same manner that a safe is opened—by means of a combination. The method of procedure is as follows: Set the plate variometers in the same position, and make the final tuning with the aerial variometer. When stations have been heard, record the reading of the dials on a chart. The same stations can be found again in the same recorded positions.

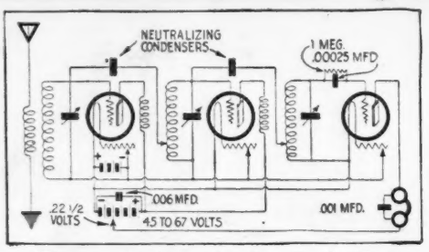
Explanation of this simple tuning scheme brings us to a consideration of the most remarkable invention of the year—namely, Professor Louis A. Hazeltine's neutrodyne principle. This system is simply tuned radio frequency amplification, with the squeal removed.

In my article last month I pointed out just how regeneration was present in radio frequency amplification. Unless the transformers are correctly designed, this regeneration is a distinct disadvantage and prevents clear reproduction.

Professor Hazeltine's very ingenious invention eliminates this disadvantage by adopting a well known principle that two equal forces neutralize each other. Now the regenerative action in a radio amplifier is caused by the internal capacity existing between the plate and grid elements inside the vacuum tube. While this capacity is extremely small, it is disastrous under certain circumstances. In the neutrodyne system it is eliminated by pitting against it another capacity of equal value. These two capacities neutralize each other, thereby destroying the troublesome capacity effects.

Fig. 2





The neutrodyne circuit: *R* signifies rheostat: *P*, potentiometer: *N*, neutroformer coils. Note positions of neutralizing condensers

Having achieved this important result, Professor Hazeltine was able to take advantage of other known laws until he obtained a step-up ratio in the windings of the interstage transformers. These transformers have four times as many turns of wire on the secondary as they have on the primary. The result is that in transformation the secondary voltage is stepped up four times, which, of course, gives further amplification.

Another important feature of the transformers is the novel method of tuning them into resonance with the incoming wave. This is done entirely by means of condensers placed across the secondary coils, with the result that the number of controls is reduced. Here the inventor has taken advantage of the laws governing coupled coils. If this coupling is extremely close, the total inductance of both coils will exist in each circuit, so that, while there are actually but 15 turns of wire in the plate circuit, the total amount of inductance will be equal to the total in the transformer.

This novel adaptation of electrical laws permits an efficient coupling of the different stages, and makes it unnecessary to insert any by-pass condensers in the grid circuit of the amplifiers.

An Important Point

An important point to remember in the neutrodyne circuit is that the secondary coil must be wound on the outside of the primary coil. The object is to screen away some of the coupling capacity that otherwise would exist between the primary coil of one stage and the secondary circuit of the preceding stage. Another point is that the transformers must be set at an angle of 45 degrees, at least six inches apart from each other, in order that they will not be in the electromagnetic fields of each other.

These, however, are only variations of the basic system of "tuned" radio. A glance at the diagrams of the two systems will show how both are much alike, and it will bear out the fact that I have tried to emphasize in this series—that all circuits have a definite reason for existence, and that all are based on the same fundamentals.

The third system (Fig. 3) shown on this page is a simple "tuned" radio reflex circuit. In the September article I explained in detail the reflex system. The circuit shown here is unquestionably the simplest of the reflex adaptations. It is one with which we have experimented extensively and which has given very good results both as a distance getter and a volume giver.

¶ Next month Jack Binns will describe the various types of vacuum tubes used in radio.

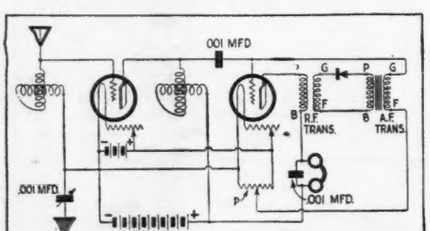
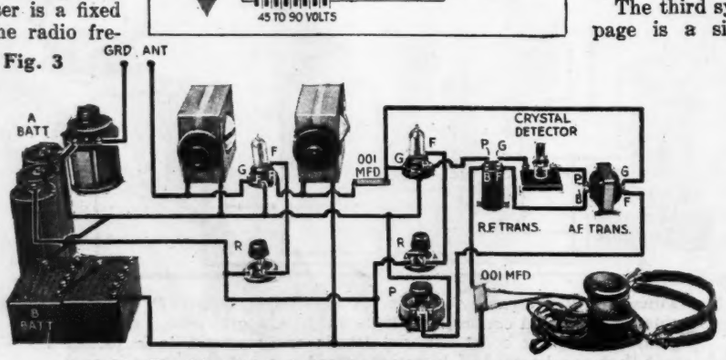


Fig. 3

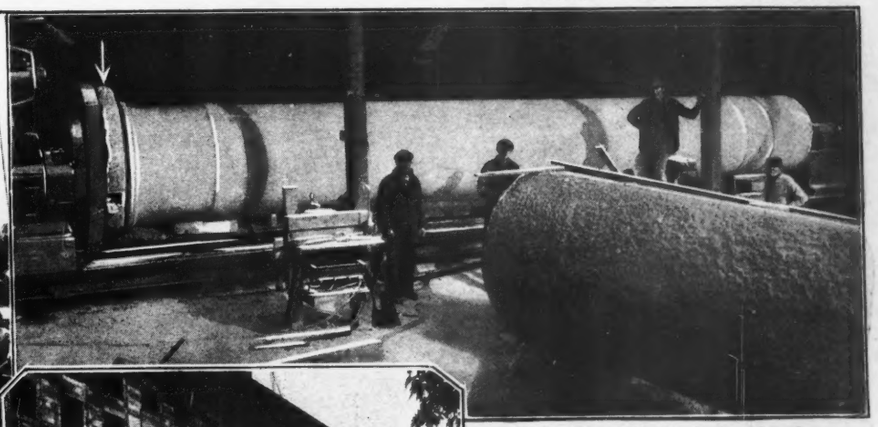


Combination of tuned radio frequency and reflex circuit: *R*, rheostat; *P*, potentiometer

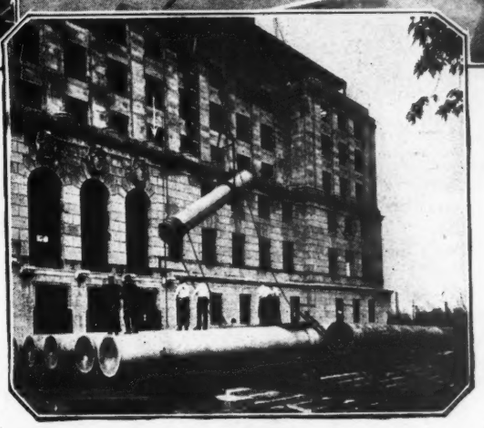
Largest Cut Stone Columns of Modern Times

Photograph courtesy Travelers Insurance Co.

Rigging apparatus required by the great size and weight of the columns



A "trimmed" block in the foreground, and a column on the lathe



A column being hoisted to its pedestal (see arrow) on the new South Office Building at Harrisburg, Pa.

THE largest single blocks of cut stone quarried in modern times, 36 in number, were erected recently as the columns of the new South Office Building at Harrisburg, Pa. Each of these blocks was five feet in diameter and 33½ feet long, and each weighed, in the finished state, approximately 40 tons.

It is said that the ancients, notably the pyramid builders of old Egypt, quarried and transported still larger blocks.

These modern columns are of Indiana colitic limestone. The roughly hewn blocks from which they were cut weighed 90 tons each. These rough blocks were trimmed, or "scabbled," by hand tools into a cylindrical shape. By this process the weight was reduced to 75 tons. The final shaping was done on a lathe, specially constructed with considerable ingenuity to accommodate the unprecedented size of the blocks.

The finished columns were taken on flat cars from Indiana to Pennsylvania, their size and weight making necessary the employment of unusual rigging apparatus when they were lifted into place. It is worthy of note that these columns were quarried, delivered, and erected without damage to property or persons.

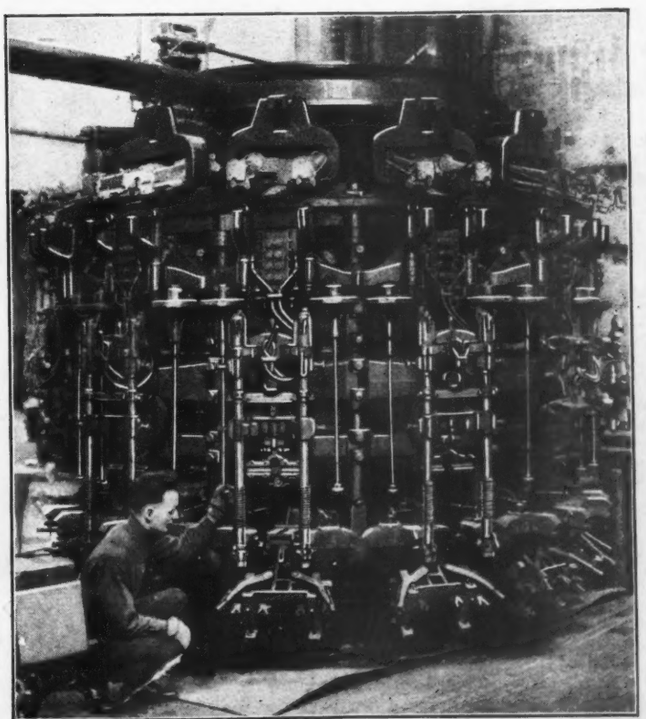
Mechanical Marvel Blows Incandescent Bulbs

THE remarkable machine shown here, recently installed in the National Lamp Works of the General Electric Company at Cleveland, Ohio, performs all the operations of blowing incandescent lamps, having a capacity of 50,000 bulbs a day. The machine has as many as 14,000 parts.

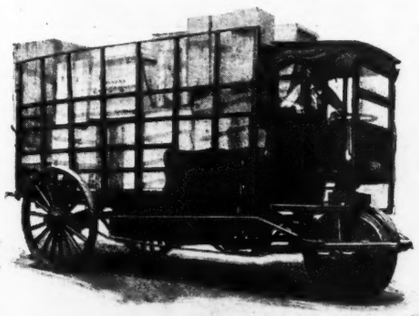
Twenty-four great arms at its sides reach out and take the molten glass from a tank. A small, sharp knife trims the bubble of glass to the proper size. Compressed air then inflates the glass slightly, and in this condition it is placed in a mold, where compressed air shapes it properly against a steam cushion. The process is incredibly rapid, perfectly formed bulbs being deposited on a platform an instant after the arms have taken the molten glass from the tank.

An annealing machine, to which the lamps are carried by a conveyor, then automatically removes minor imperfections if its vigilance discovers any. The bulbs are inspected by hand at the end of their journey.

The infinite precision with which so many of the operations involved must be performed makes the development and successful operation of the machine the more remarkable.



This complex mechanical giant, with 14,000 parts, blows 50,000 incandescent light bulbs a day, a task involving infinitely precise operations. Compressed air blows the bulbs



This Three-Wheeled Truck Reduces Upkeep Costs

A THREE-WHEELED electric truck that is readily handled in confined spaces and can be turned about in the space on which it stands, has been developed by a Chicago firm.

The truck is driven by the front wheel, inside of which the motor is mounted. The motor pinion engages a circular rack on the interior of the wheel. Steering is accomplished by turning the front wheel, and the connection between the steering column and the wheel is made by means of a pinion on the lower end of the column that engages a circular rack.

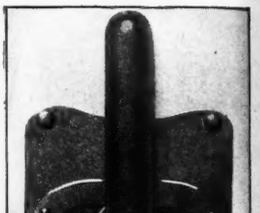
It is claimed that the motor and drive mechanisms have been reduced to the simplest form through the elimination of steering knuckles, differentials, chain drives and auxiliary parts. This elimination also reduces maintenance expense and time and labor loss.

The truck was developed originally from a horse-drawn truck owned by the company, for which some use was sought. The motor wheel and battery were attached to the truck and experiments evolved the machine here shown.

Useful Ideas for Home Convenience

In every kitchen where space is at a premium, this combination kitchen cabinet and refrigerator will be found unusually serviceable. The cabinet is clamped to the top of the refrigerator. Either part of the combination may be obtained separately—icebox or cabinet

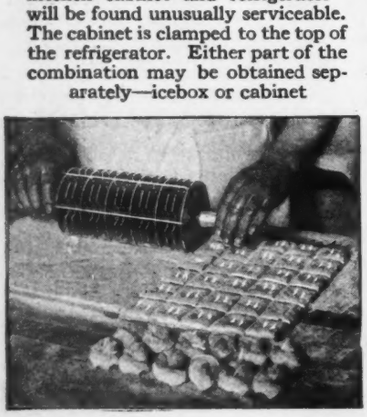
Pots and pans, no matter how hot, may be lifted by means of the device shown above. A lever operated by the thumb spreads the wire wings that grip the edges of the pan



An automatic broom holder has an arrangement of two mechanical fingers, tipped with rubber pads, that tightly grip the broom handle when it is inserted

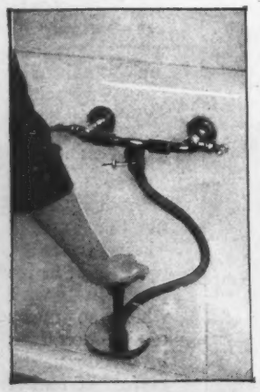
A novel ash dust remover consists of a smoke outlet pipe terminating in a cover that fits the top of the ashcan. This cover has a slanting chute into which the ashes are shoveled. The outlet pipe runs to furnace smoke pipe

Equipped with three sets of powerful jaws, a new universal opener is said to remove caps of all sizes. An extension of one of the jaws is a bottle opener

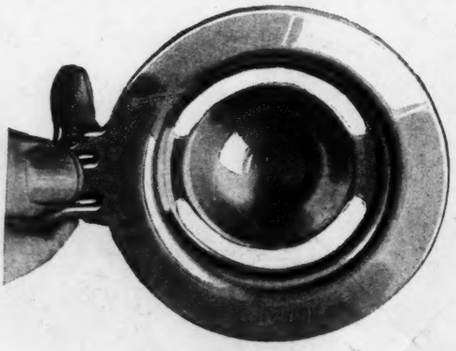


This rapid cruller cutter contains a series of sharp knife edges so arranged as to cut the dough in cruller shapes. One complete revolution of the roller cuts 30 uniform crullers

Designed to remove smoke and cooking odors from the kitchen, this electric ventilator fan can be installed easily in the top of a window. It has a capacity of 500 cubic feet of air a minute



Concentrating the force of the water, this sanitary flusher drives waste down the pipes of sink or bath



This handy aluminum egg separator is placed over a cup. When the egg is broken into it, the yolk remains in the cup-shaped center, while the white runs through the circular slits into container below

How to Keep Linoleum-Covered Floors Clean

Science Perfects a Mineral Lumber

"Wood" of Asbestos and Cement May Save Our Forests

THE housing shortage of the last few years has necessitated the building of dwelling houses on an unprecedented scale. Particularly has this been true in suburban and semi-rural sections where, almost without exception, the structures are of wood.

The result has been that the capacities of the country's mills and lumber yards have been taxed to the utmost. The consequent drain upon their diminishing timber lands has been so severe that Secretary Henry C. Wallace, of the Department of Agriculture, recently stated that the forests of the nation were entirely inadequate for present-day building needs and that the complete exhaustion of our lumber resources would result unless the demands on it were curbed.

A "Forest" of Asbestos

Then, as so often in the history of the world, science responded in the hour of man's need.

A new timber country was discovered, from whose bountiful supply man may hew and cleave the walls and roofs of his dwelling places for centuries. This new "forest" is beneath the earth, where it has grown and flourished since before the dawn of history. It is the mysterious vegetable mineral asbestos, well known because it will not burn.

Science has combined the tough and indestructible fibers of asbestos with cement to create a "wood" that can be substituted for lumber sawed from the forests. It can be sawed, nailed, and shaped. It can be fashioned in sheets one eighth inch thick for decorating interior walls. It can be made into huge timbers. It can be molded into thick strips for exterior walls or into thinner sheets for flat roofing or shingles. It can be painted, sanded, stained, and treated in any way in which ordinary wood can be treated for decorative effect. But, unlike ordinary wood, it requires no treatment for preservation, for it is practically indestructible.

The construction of the giant machines shown on this page has made possible the manufacture of asbestos wood in sizes and shapes suitable for building work. One of the machines is a huge hydraulic press, whose enormous jaws grind together with a force of 90,000 pounds to the square inch. Some idea of what an enormous pressure this is can be obtained by considering that it is equal to the weight of a column of granite one foot square and 13.8 miles high.

Into the gaping mouth of this press pours a thick stream of moistened cement and asbestos fibers, in amounts predetermined according to the shape and weight desired in the asbestos wood being made. The tremendous pressure squeezes every bit of air and superfluous moisture out of the mixture, almost immediately setting the cement. Thus is produced a homogeneous piece of wood that will neither rot nor burn.

As the wood issues from the machine, it is gray. Exposed to the weather, its color gradually becomes darker, but it will always remain gray and the substance itself will suffer no change. Any color scheme desired, however, may be obtained by the use of paint, enamel, varnish, shellac, or flat colors.

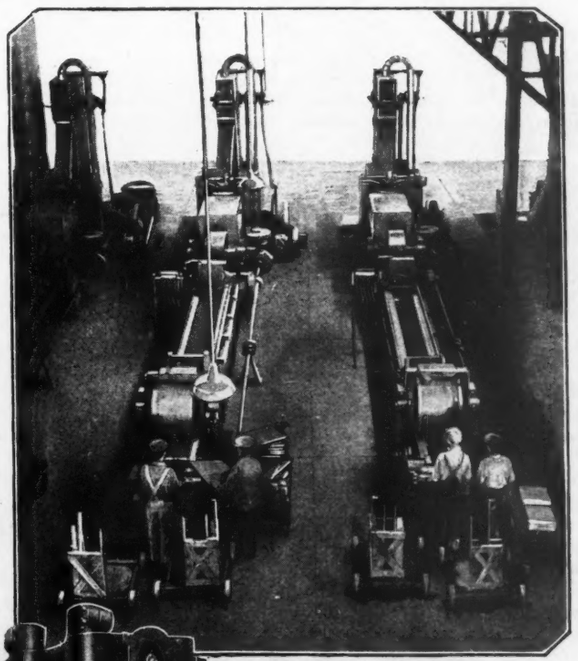
Age Improves This "Wood"

A remarkable feature of the wood is that it actually improves with age, for asbestos does not deteriorate with time, and cement hardens as it ages.

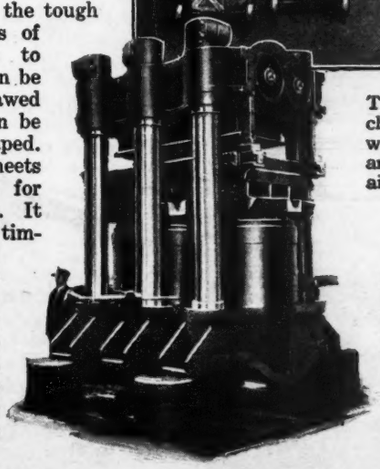
The future of asbestos wood is, of course, a matter for speculation. It has been shown to do away with the maintenance cost necessary with the use of both wood and iron. Rotting boards must be replaced constantly, and stringent and expensive methods are necessary to protect iron against its insidious enemy, rust.

Small houses and warehouses already have been constructed successfully of asbestos wood, and it has been used with equal success in the partial construction of larger buildings. Its present uses have demonstrated its superior qualities in widely divergent fields. Its resistance to fire is a precious quality; a great boon to mankind. Fireproof carriers, both mail and motor, may be constructed of it. There is almost no limit to the dimensions and shapes to which it can be pressed.

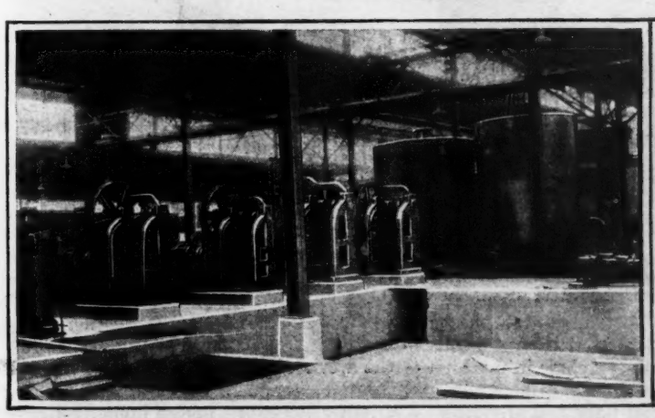
Certainly the new product will go far toward relieving the lumber scarcity which is a source of anxiety to our scientists and our government.



This shingle cutting machine cuts the asbestos wood to any size or design, and punches nail holes to aid in laying the shingles



At left: The enormous hydraulic press that compresses the asbestos fibers and cement into blocks and sheets of the new fireproof "wood"



These powerful pumps and the great accumulators shown in the background assemble the asbestos fibers and the cement from which science fashions the durable new mineral lumber

The switchboard of a New York power station, made of "asbestos ebony"—asbestos wood treated with an insulating compound. Asbestos wood furnishes safety and decoration

Cooking Better Food with Less Gas

How to Keep Linoleum-Covered Floors Clean

Scrubbing with electric brush | 2. Removing the dirty water | 3. Applying the liquid wax | 4. Polishing with weighted brush | 5. Sweeping with soft brush

SCRUBBING linoleum—the only treatment it receives in the average household—will make the floor clean, but it will not *keep* it clean. And linoleum, according to a prominent manufacturer, should be scrubbed not more often than three or four times a year.

A method for keeping your linoleum-covered floors always new and always clean at a minimum expenditure of effort is shown in the above pictures.

The first step in the process is scrubbing. The operator in the picture No. 1 has an electric scrubbing brush, but an ordinary hand brush will serve equally well.

Next, remove the dirty water remaining from the scrubbing. A rubber squeegee and metal floor pan are best for this purpose, but the ordinary cotton floor mop, or even a floor cloth, will serve.

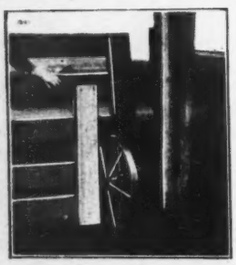
The third step is waxing. Paste wax, which usually is applied with a cloth, may be used, but liquid wax is recommended as easier to apply. But whatever wax is used, make sure that it is applied lengthwise of the floor, then crosswise to insure a complete covering of the floor with the wax.

When the wax has dried—after about 20 minutes—it must be rubbed to a polish. A weighted electric brush is best for this purpose, but a flannel cloth, well padded about a brick or some similar heavy block, can be used if the brush is not available. If the brush is used, it should be covered next with a cloth and the floor again rubbed to harden the polish. In other words, linoleum is polished like shoes—first with a brush, then with a cloth.

The last step in the process is sweeping with a soft brush to remove bits of wax and lint.

This treatment, it is said, need not be repeated more often than every three months, and, in the intervals between polishing, the linoleum will need no further attention than occasional sweeping to remove dust.

Farm Gate Swings on Wheel

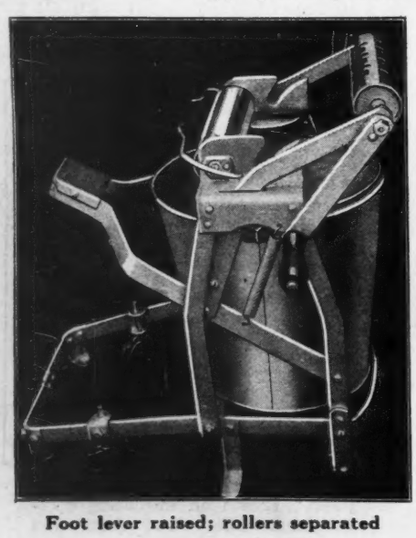


A FARMER of Minnesota has solved the problem of opening and closing his gate easily by attaching at the end a wide-tired wheel that describes a circular path as the gate swings.

New Steel Wringer Adds Life to the Mop

LONGER life for mops that now are wrung by being dragged between untrue and slippery wooden rollers, is promised by a newly designed wringer shown below.

The mop is inserted between a perforated steel roller and a solid roller brought together by pressure on a pedal, holding the mop firmly. A handle turns the rollers and wrings the mop. Slipping is impossible



Foot lever raised; rollers separated

High chair seat is suspended from straps hooked over the back of an ordinary chair

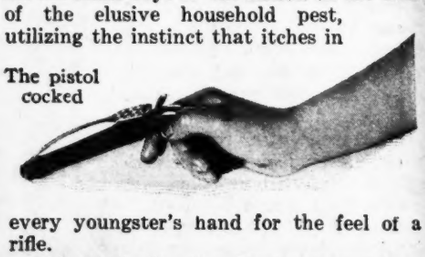
Baby's High Chair Formed by Strap Attachment

NO LONGER need the family Bible, the dictionary, and the Complete Works of Shakespeare be stacked upon a dining-room chair when a guest brings a child to dinner.

The ingenious British invention shown above makes possible almost instantaneous conversion of an ordinary chair into a high chair. Three stout hooks grip the top cross piece of the chair back and an adjustable strap arrangement supports a strong, comfortable seat for the child.

Fly-Swatting Pistol Sport for Small Boys

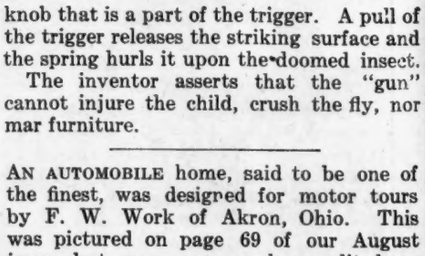
BAD news for the fly. The inventor of the fly-killing pistol shown here hopes to set the small boys of the nation on the trail of the elusive household pest, utilizing the instinct that itches in



The pistol cocked

every youngster's hand for the feel of a rifle.

A death-dealing "swatter" actuated by a strong spring in the pistol is held back by a



A pull on trigger releases swatter

knob that is a part of the trigger. A pull of the trigger releases the striking surface and the spring hurls it upon the doomed insect.

The inventor asserts that the "gun" cannot injure the child, crush the fly, nor mar furniture.

AN AUTOMOBILE home, said to be one of the finest, was designed for motor tours by F. W. Work of Akron, Ohio. This was pictured on page 69 of our August issue, but was erroneously credited as the work of Mr. and Mrs. C. F. Rouze of Pontiac, Mich. They designed and built another luxurious motor home, containing an ingenious bath, pictured on the same page of the August issue.

Wild Animal Hunters

Cooking Better Food with Less Gas

Uncle Sam's Tests with Standard Burners and Ovens Show How to Save Money and Enormous Quantities of Heat

WOULD you, husbands of America, like to save from 25 to 50 per cent on your household gas bills?

Would you, wives of America, like to help in the saving and at the same time see that the meals you cook, or whose cooking you direct, are prepared scientifically and efficiently?

If so, look to your kitchen gas range and learn its ways; for there lies your chance of achieving both these goals.

Study Your Stove

Your gas range is a mechanical device, not a particularly complicated one, it is true, but still possessing with all other mechanical devices a common characteristic—it can be used correctly and it can be used incorrectly.

Recently in her work as assistant chief of the Office of Home Economics, United States Department of Agriculture, Dr. Minna C. Denton has conducted numerous tests of gas ranges, and as a result of those tests, is in a position to lay down certain easily understood rules for the correct and economical operation of a range. Some of these rules are outlined as follows:

The first thing to be investigated is the flame you use. The hottest flame—which means the flame that will do the most cooking with the least expenditure of gas—is blue; not red, nor yellow, though flames of these colors may appear much hotter. A blue flame—with a tiny tip of yellow—may be obtained by turning the air adjustment device that you will find on the pipe leading from the gas cock to the burner—a device most people neglect entirely.

The Blue Flame Is Important

Different ranges will require different methods of adjustment to obtain the proper flame. You will have to experiment to determine how the best flame is to be obtained on your stove; but keep at it until you get the quality of flame described above, for it is a matter of prime importance.

When you have made this adjustment, the next thing to consider is the burner you are to use. The largest burner on your stove consumes probably 50 per cent more gas than the next smaller one, so it is manifestly absurd to use this big burner unless you are cooking a large quantity of food in a large pot.

As a general rule, use a burner of a size that will not permit the flames to lick around the edges of your pot or pan.

Don't fail to use the simmering burner—the smallest on your range. Many housewives never light this burner, which is wonderfully useful in keeping things boiling once they are started on the larger burners. Its use brings about a considerable saving in gas.

Select a stove with burners that will lie not more than from one to 1½ inches below the bottom of the pan. Long flames use much more gas than short ones to produce the same effect.

Be sure that burners are clean and jets kept open.

When food has started to cook, turn down the flame. A high flame is uneconomical and will result in little additional speed in cooking.

Your oven, too, unless it is properly constructed, maintained, and operated by you, is a constant source of waste. Examine it to be sure that it is tight and doesn't permit the escape of heat. Interlining the walls of the oven with asbestos will conserve an enormous quantity of heat; but, whether you have an oven so constructed or not, be certain that all cracks, especially about the edges of the door, are closed.

Whenever possible, bake at low temperature. You will find that the difference in time between a "fast" oven and a "slow" one will not compensate you for the difference in gas consumption. There are several oven thermometers on the market that will tell you at a glance the exact temperature at which you are baking.

Tests conducted in Uncle Sam's Office of Home Economics at Washington, D. C., showed that an interlining of asbestos between oven walls will conserve enormous quantities of heat while cooking a meal

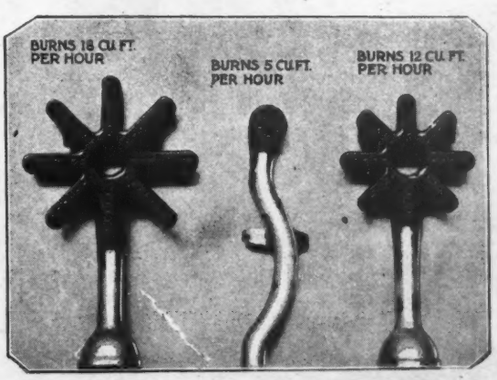
Other Types of Cookers

A fireless cooker will save gas, but only if used properly. Do not overheat the stones. Certainly there is no economy in using as much gas to heat the stones of a fireless cooker as you might use to perform on your stove the same cooking operation.

Pressure cookers also are useful in reducing gas consumption, especially in the preparation of tough meats, vegetables, and cereals. The hooded fireless burner, made by some manufacturers, also is a fuel saver.

The tests on which Doctor Denton based these rules were entirely practical. Using well-known brands of gas ranges, she actually cooked meat, vegetables, and puddings, baked bread and biscuits, boiled water; in fact, performed with the ranges under test the same operations that housewives all over the country are performing every day. Records were made of the gas consumption and of the time taken to complete each task of cookery.

The results of the tests are the rules here outlined. Follow them, and you will find that they will give a real saving in gas, labor, and food that is properly prepared.



Typical burners of three sizes. The tests showed that the largest burner consumes 50 per cent more gas in cooking than the next smaller one

Many Uses for Old Corks

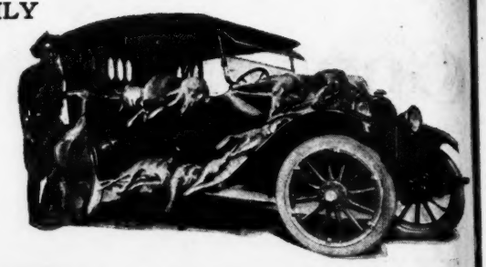
OLD corks can be used in many valuable ways about the house. Spots and blemishes on window glass nearly always will disappear if rubbed with a dry cork. Moistened with turpentine, it will remove marks from hearth tiles or white glaze bricks. Rust spots on metal can be removed by cork dipped in paraffin; spots on linoleum by cork dipped in gasoline. Burnt marks on pie dishes and plates will vanish if treated with a cork dipped in wet salt.

An effective foot warmer for cold winter nights may be made by cutting corks into small bits, filling a flannel bag with them, and heating for 10 or 15 minutes.

Can Your Jaws Lift Jack Dempsey?

Wild-Animal Hunters Save U. S. Millions

Champion, at 70, Has Bagged 500 Lions



A government hunter bringing in a carload of Arizona coyotes

WAS there ever a small boy who did not dream of happiness in the wilderness, surrounded by perils, but downing with each bang of his trusty rifle another leaping, roaring lion?

Ben V. Lily, champion hunter of the United States Biological Survey, was such a boy. And he has just celebrated two anniversaries, one his seventieth birthday and the other the completion of 60 years as a big game hunter.

Wild Beasts Are Plentiful

Lily carries on his story-book career, not in the jungles of Africa or India, but right here in the United States. We might well imagine that development of commerce and the practical application of science in America have eliminated the dangers to life and property from wild beasts. Yet, with the recording of Lily's seventieth birthday the United States Biological Survey chalked up to his credit the bagging of his five-hundredth mountain lion. At the same time official estimates show that his campaigns against predatory animals in New Mexico actually have saved stockmen of the Western states several million dollars a year. Lily hunts with dogs and on one occasion is said to have worn out four packs before bagging his quarry. Another time he trailed a bear 400 miles and killed it.

The story of Lily's remarkable career recalls the fact that there is still a "Wild West," and that even in these days of comfort and security constant battle is necessary against the depredations of savage beasts.

Eighty thousand predatory animals was the bag of Uncle Sam's riflemen last year. They shot, trapped, or poisoned 687 timber wolves, 173 mountain lions, 114 bears, 2827 bobcats, and 77,185 coyotes.

Before the army of government hunters was enlisted, the tooth and fang tribute collected annually by the predatories amounted to $30,000,000. In seven years the sharpshooters have killed 380,000 stock-killing beasts, and thus are given credit for saving $35,000,000 worth of domestic live stock. They are modern minute men, for they are always ready to answer the call of stockmen and ranchers who report the presence of obnoxious freebooters. There are 266 of them in the Western states.

Captured—a Captain Kidd of the Western plains. Here is a typical prairie wolf, stealthy and wise, trapped in his crafty search for livestock prey

Among these hardy men, the heir apparent to Lily's title as world champion is Charlie Miller, who killed 20 mountain lions in the first two months of this year. The value to stockmen of this big bag is shown by the government estimate that each adult mountain lion destroys at least $1000 worth of live stock every year. To Miller last year went the credit of poisoning a wolf near Flagstaff, Ariz., that had eluded hunters for seven years and terrorized flocks and herds, causing a loss of more than $10,000.

Above: Setting traps for coyotes. At the left is Ben V. Lily, American champion big game hunter who at the age of 70 has killed 500 mountain lions

Some Record Bags

Other government hunters have made record kills in the campaign against predatory beasts. In three hours Lloyd Thompson, a government hunter stationed in Montana, and his dog rounded up and killed five mountain lions.

W. E. Cozzens, of Idaho, has won fame as a wolf hunter and has proved himself quite as cunning as the animal he seeks. He dresses in white and glides about on skis during the winter. He steals up on the wary wolves before they detect his presence. Last winter he accomplished the feat of shooting five wolves in a pack in this manner without a miss. Cozzens has bagged 80 destructive wolves in the last few years.

One of the 30 government inspectors in the 15 Far Western states tells of a government hunter who bagged five mountain lions and a bobcat in three days.

"Some wild animals kill for blood lust only," says W. H. Caywood, one of Uncle Sam's best wolf hunters. "A Rocky Mountain wolf, for example, kills just for the love of killing. Once I saw a pack of wolves drive a dozen cattle over a precipice out of pure devilment."

Coin Clock Saves Money when You Wind It

FOR the benefit of people who haven't learned how to save money, a Cleveland manufacturer has devised an ingenious clock, which requires winding every 24 hours, but which cannot be wound unless a nickel, a dime, or a quarter is dropped in a slot to release the spring.

The clock is small, 2⅛ in. in width, but, if its possessor keeps it running, its capacity is sufficient to add many dollars a year to his savings account.

The clock has found wide use among banks of the Middle West, which use them to encourage thrift on the part of new depositors.

Can Your Jaws Lift Jack Dempsey?

By Arthur D. Black, M.D., D.D.S.
Dean of Northwestern University Dental School

POSSIBLY you are aware that the human jaw is very strong. You have seen circus performers swinging from trapezes or raising enormous weights by the grip of the teeth. But do you know that the muscles of your own jaw, developed merely by the necessary work you perform in chewing your food, possess power enough to lift from the ground a man as large as Jack Dempsey?

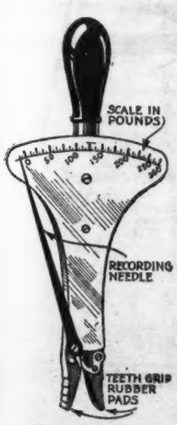
Tests of the jaw power of many thousands of persons offer some surprising facts regarding the strength of the average human jaw. A person of normal strength and with useful teeth can exert more pressure between his back teeth than he can produce by any other part of his body. The bite of the jaw is stronger than the grasp of the hand, the pressure of one hand against the other, or the grip of the knees. It is greater than the weight of the whole body of any but exceptionally heavy persons.

The average jaws possess a biting power of 171 pounds, the jaw strength of thousands of persons examined varying between 25 pounds and 260 pounds. The figure of 260 pounds does not, however, necessarily represent the maximum power of the jaw.

The instrument by which the power of the human jaw is measured, called the gnathodynamometer, is constructed to register no higher than that figure. Doubtless many persons can bite as much as 300 pounds.

Just how great a force 260 pounds is can be realized when I say that it is equivalent to the greatest weight the average man can lift from the floor with one hand, using his back, legs, and every other muscle to aid him.

The strength of the bite as registered on a recording instrument depends not so much upon the muscular power of the person being tested as upon the condition of his teeth. This condition depends in turn upon the habitual use of the teeth. Wrong advice that most of us receive early in life is responsible for the fact that we shrink from attacking with our teeth hard substances that would yield to them readily.



This device measures jaw strength

A normally healthy child will attempt to chew almost anything that appears to be edible. It will crack nuts and gnaw on hard candy and its teeth will suffer no harm. On the contrary, the tissues supporting the teeth will be strengthened and hardened as those of an animal are hardened from chewing on bones and other hard substances. Misinformed elders, however, will warn the child against this instinctive use of the teeth for the purposes for which they were designed. The result is that the child acquires fear of biting on hard objects, and its teeth, lacking the exercise they need, do not receive the thorough scrubbing which results from vigorous mastication.

I have seen many persons, who, accustomed to chewing only on soft foods, have registered a bite of only 30 pounds under test. A change of diet, which included a fair proportion of hard foods, worked wonders with these persons. Within a month their teeth were capable of exerting a pressure of 100 pounds, and three or four months of the treatment raised the strength of their bite to 150 pounds.

Years ago in the West, hazel nuts with tough shells, requiring between 150 and 200 pounds pressure, grew wild, and people cracked them with their teeth. Those same nuts are cultivated and soft-shelled now, requiring only half as much jaw force. Yet today few people would dare attack them with their teeth.

All of us should use our teeth freely on hard foods. It is a commonly expressed fallacy that teeth which have been filled are to be spared in chewing. This is not true. If the dental work has been done properly, the filling will be more than equal to withstand a pressure of from 125 to 150 pounds. This is the greatest force the jaws ordinarily will be called upon to exert.

The toughest beef will yield to a grinding force by the teeth of from 70 to 90 pounds. Better cuts of beef may require as little as 45 pounds pressure from the jaws. Mutton may be chewed with a force of between 30 and 45 pounds. Roast veal requires from 35 to 45 pounds, pork from 30 to 35 pounds, corned beef from 30 to 35 pounds, and broiled ham from 40 to 60 pounds. Among meats, cold boiled tongue can be chewed with the least expenditure of jaw energy, between three and five pounds sufficing.

To those who may fear to break their teeth by biting on hard substances, let me say that, provided their teeth are in good condition, they will not be harmed by small bones or stones, birdshot or similar materials that accidentally may get into the food. Tests conducted on a specially constructed dynamometer show the teeth to be much stronger than any of these materials.

Freshly extracted teeth placed in this machine resisted much stronger pressure than stones, metals, and other substances which the average man would regard as being considerably harder than his teeth.

© Keystone

The acrobats' teeth hold organ and player

Gus Lessis, strong man of Brighton Beach, N. Y., bending and breaking a thick iron spike with his teeth. The spike was embedded eight inches in a wooden beam

How Much Power Do You Use when You Eat?

"THE toughest beef will yield to a grinding force of from 70 to 90 pounds," says Doctor Black. "Mutton may be chewed with a force of between 30 and 45 pounds. Roast veal requires from 35 to 45 pounds, pork from 30 to 35 pounds, corned beef the same, and broiled ham from 40 to 60 pounds."

Oiling and Greasing Your Car

Costly Repair Bills, Even Accident or Death, May Be Penalties of Neglect

By F. A. Platte
Instructor, Department of Physics, Columbia University

RECENTLY I found a neighbor stalled by the roadside. His machine was in the ditch. His clothes were covered with mud. He was white and shaking.

"The steering gear broke and I was nearly killed," he said. "Only the soft mud of the bank saved me."

I went over and looked at his car. A steering knuckle had broken.

"If you had oiled your car properly, this never could have happened," I told him.

"Oil?" he said in surprise. "What has oil to do with it? Besides, I filled my crankcase just before I left the garage. Even now the gage shows it nearly full."

I picked up part of the broken knuckle. It had worn thin. "When did you oil your steering apparatus last?" I asked.

"Oh, I never oil that," he replied.

That neglect nearly had cost him his life. Because of the lack of oil, the constant friction on the steering knuckle had worn it thin. It had snapped suddenly under a quick strain.

But how many motorists oil their steering gears or any working parts other than those of the engine? Not many. That is why automobile manufacturers are fairly correct in their estimate that 75 per cent of all repairs and 50 per cent of all depreciation is due to inadequate lubrication.

When you receive your car from the dealer, all parts are well greased and oiled. Ask him then what oil to use in the crankcase at each season of the year. Different makes of cars require different types of oil. He will tell you the particular needs of the car you purchase.

The crankcase is the most important single oiling locality because from it are oiled all the working parts of the engine interior. Always keep it full—your gage will tell you when it is—but avoid flooding. A heavy white or blue smoke from your exhaust means too much oil.

After running about 500 miles, drain all the oil from the crankcase by unscrewing the plug in the bottom, generally near the rear, and letting the oil run out. Before refilling with clean oil, remove the gum and other sediment. Do this by putting about a gallon of kerosene through the filling tube after replacing the drain plug. Then, with the ignition off to prevent starting, press the starter button and allow the turning motor to splash the kerosene about. If you have no starter, use the crank.

Now remove the drain plug again, giving the starter a few turns while the kerosene is running out. Then fill your crankcase with new oil. About every 1000 miles this refilling operation should be repeated. Inspect your crankcase every day.

The misconception that all lubrication centers in the crankcase is the greatest cause of depreciation. Although the crankcase takes care of all moving parts of the engine interior, about 40 other places on the average car need oil or grease. These should be inspected and lubricated regularly.

Parts needing attention weekly are the spring shackle bolts, steering gear, fan bearing, and brake mechanism. The shackle bolts are at the ends of the springs and from them is suspended the chassis. At the ends of the bolts you will find a grease cup or grease gun fastening. If cups, fill them and give them two turns every day or so; if grease gun holes, force in heavy grease until the old black grease oozes out through the joints.

You will find an oil hole near the steering wheel which will lubricate the connection with the steering column. Next, grease or oil the reach rod clevis bolts, reach rod ball and sockets and the worm gear. Where there are grease cups, do as you did for the shackle bolts. Where there are oil holes, drop in some light lubricant from a can.

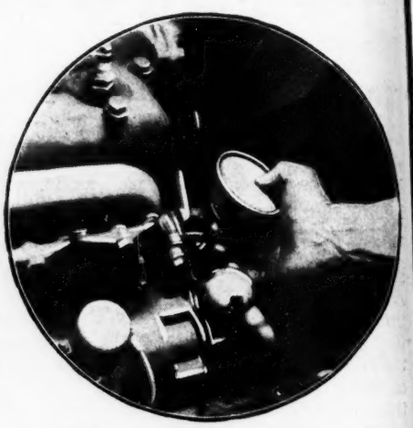
The fan bearing needs a few drops of light oil through the oil hole.

Follow the brake mechanism through the car each week, injecting a reasonable amount of light lubricant at the several joints. The emergency brake should be treated similarly.

Where the front wheels are connected with the axle, you will find the steering knuckle usually with a small oil cup. Keep this filled with oil, not grease. Lack of lubrication here causes wabbly wheels.

So much for the weekly lubrication.

Every month the rear shaft bearing, universal joints, transmission rear support bearing, clutch, generator, distributor, and



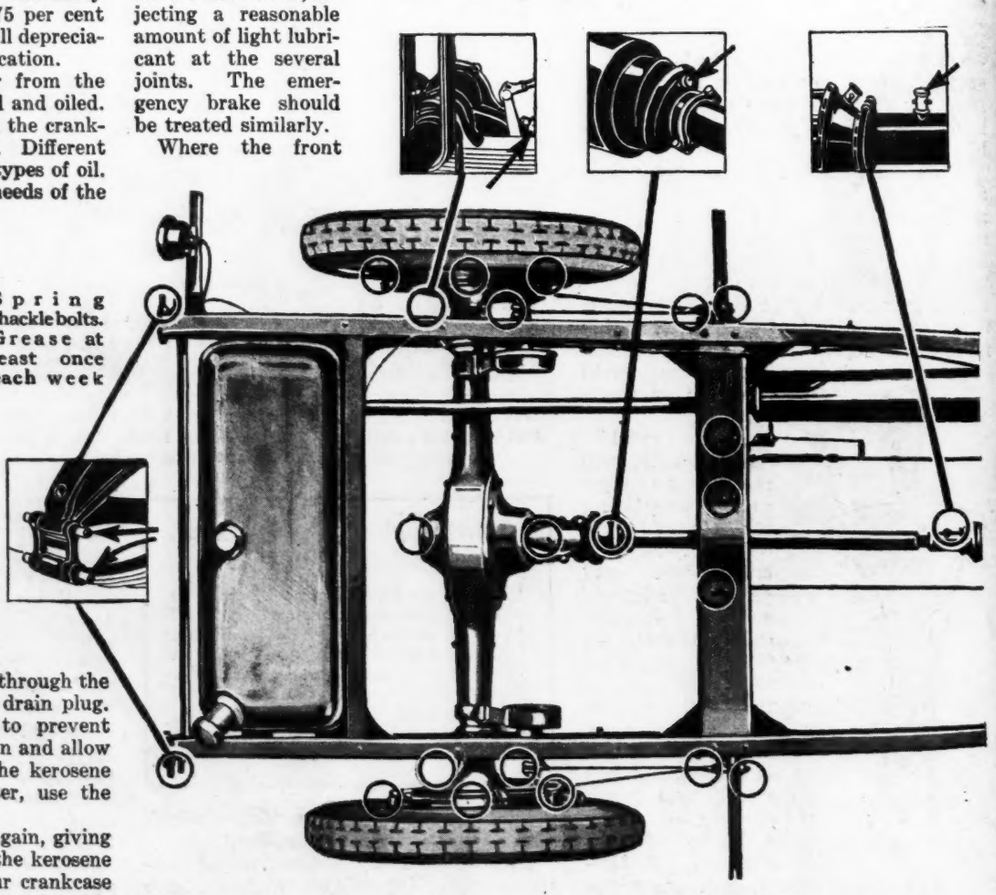
Where most oilcans never explore—the auto's fan bearing

Rear axle shaft bearing and emergency brake cam. Grease monthly

Rear universal joint. Grease at least once each month

Front universal joint. Grease at least once a week

Spring shackle bolts. Grease at least once each week



Just Where and How to Grease and Oil Your Auto

The above diagram illustrates graphically the precise locations of those vulnerable points where grease and oil can save you money, inconvenience, and sometimes serious accident. Most of these strategic points are ignored by the average car owner

Sliding Gear Simplifies Transmission

starting and horn motors should be looked to.

Usually there is a grease cup on the rear axle shaft bearing, just outside the frame near the brake bands. Fill this with the kind of grease used for the spring shackle bolts. When lubricating this part inspect the axle housing to see if oil is running out on the brake bands. If so, have the joint made tighter.

Next come the two universal joints at the end of the long transmission shaft connecting the gearset and differential in the rear. A fibrous grease made for this purpose should be forced into the grease cups here. Behind the gearset is the transmission rear support bearing, which requires oil, not grease, monthly. Here you will find usually a capped oil hole.

The clutch mechanism should be followed through and all working parts and bearings lubricated with a medium oil. The clutch throw-out bearing has a cup needing heavy grease.

Among parts likely to escape attention because of inconspicuous or not easily accessible location are the generator, usually near the fan; the distributor, from which rubber insulated leads go to the spark plugs; and the starting and horn motors. Use a few drops of oil wherever there are oil holes, taking care not to flood the distributor parts.

Every three months, you should clean out old oil and grease, and lubricate the remaining parts of the car. Put a little heavy grease or graphite on the starter chain. Fill the starter gear case with a heavy grease.

Don't forget your starting motor and generator

The plug in the transmission case, behind the shifting lever, should be removed and the case filled with heavy transmission oil or light grease. Treat similarly the differential housing on the rear axle, filling up the cases to the level of the oil holes.

It is important that the oil and grease in these parts be not too heavy, since the rapidly rotating parts have a tendency to throw the material out against the case. A heavy grease will be thrown against the walls and stick there, leaving a hole in the center in which the operating parts rotate without any lubrication. This will soon cause wear, and new gears will have to be supplied.

A long walk on a hot, dusty country road once impressed on my mind the importance of proper lubrication in the differential. I had gone driving with a friend. When we were about six miles from the nearest town, something broke. The car stopped with a grinding sound. We made an inspection and found a small pinion in the differential had broken, due to lack of lubrication. The grease in the housing was too heavy and had been thrown away from the gears so that they were left hot and dry. My friend and I had a long walk to town.

But in avoiding too heavy grease, take care not to get it too light. The consistency of the lubricant should be such that it will run slowly, but should not be so light that the film will be too thin to supply proper greasing.

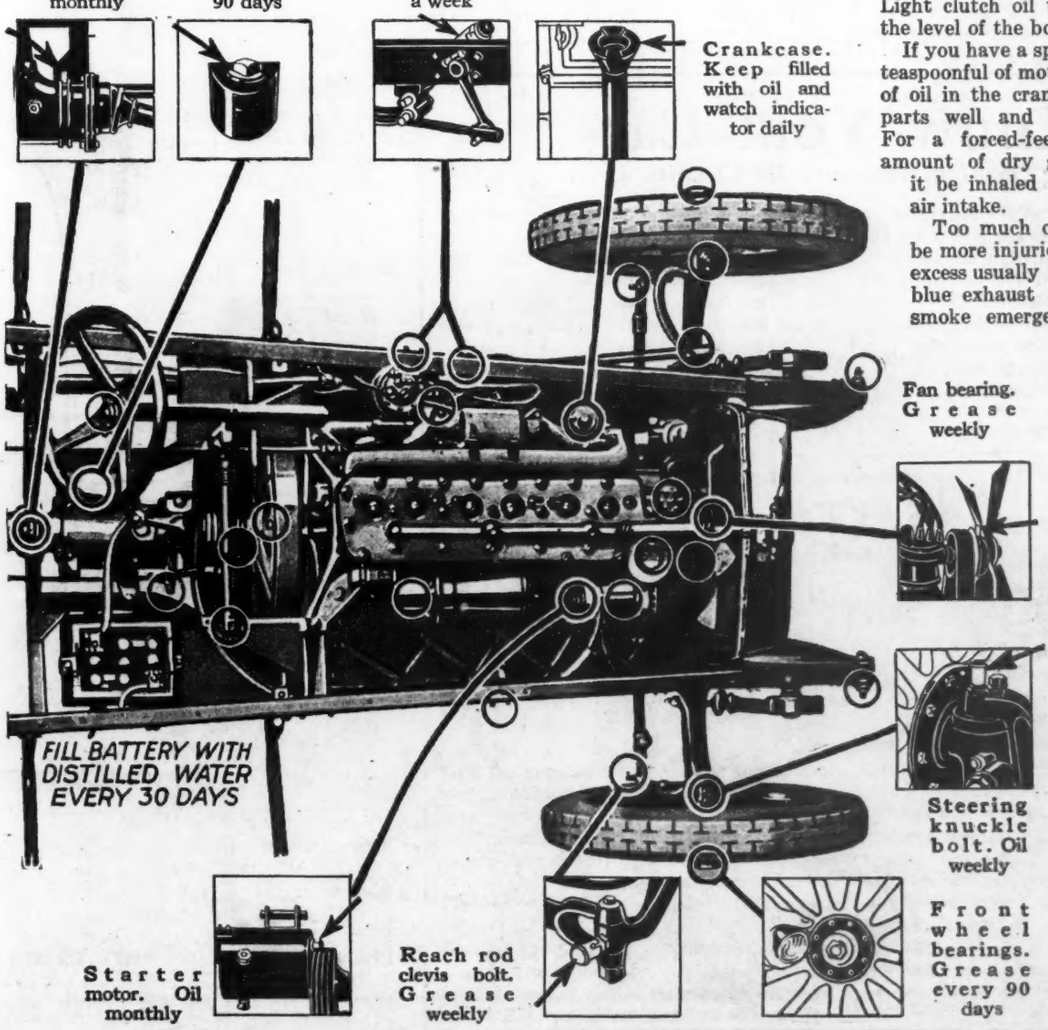
If your car has disk clutches requiring oil, all the old oil should be removed every 1000 miles at most. Do this through the drain in the casing. The clutch should then be washed by pouring kerosene into the casing and allowing it to drain dry. Light clutch oil then should be put into the level of the bottom of the clutch shaft.

If you have a splash-feed system, a scant teaspoonful of motor graphite to each quart of oil in the crankcase should polish the parts well and greatly reduce friction. For a forced-feed system use a small amount of dry graphite weekly, letting it be inhaled through the carbureter's air intake.

Too much oil in the crankcase may be more injurious than too little. This excess usually is indicated by white or blue exhaust smoke. Sometimes the smoke emerges in single puffs, indicating that only one cylinder is flooded. Whenever this occurs, clean the spark plugs.

The purchaser of a car should study the oiling chart shown here and should ascertain the type of oiling system used in the new automobile, for no time is better spent than that consumed in securing proper lubrication. If you want your car to last, you must give it the attention that engineers bestow upon the engines of the power plants that supply your home with electricity and that locomotive drivers devote to the care of their power unit.

Finally, remember always that friction is the worst foe of your automobile and that lubrication is the worst foe of friction.


Transmission rear support bearing and universal joint. Oil monthly
Transmission. Light grease or transmission oil every 90 days
Steering gear, spring and shackle bolts. Grease at least once a week
Crankcase. Keep filled with oil and watch indicator daily
Fan bearing. Grease weekly
FILL BATTERY WITH DISTILLED WATER EVERY 30 DAYS
Steering knuckle bolt. Oil weekly
Starter motor. Oil monthly
Reach rod clevis bolt. Grease weekly
Front wheel bearings. Grease every 90 days

More Service and Convenience from Your Car

Sliding Gear Simplifies Transmission

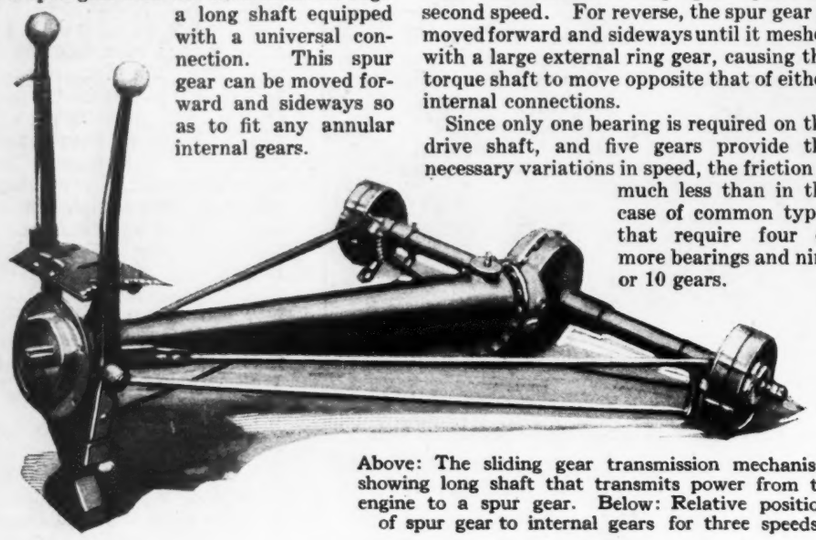
A SLIDING gear automobile transmission of a radically new type has the advantage of eliminating most of the gears and bearings that make up the present complicated transmission mechanisms.

Power from the motor is communicated to a spur gear near the differential through a long shaft equipped with a universal connection. This spur gear can be moved forward and sideways so as to fit any annular internal gears.

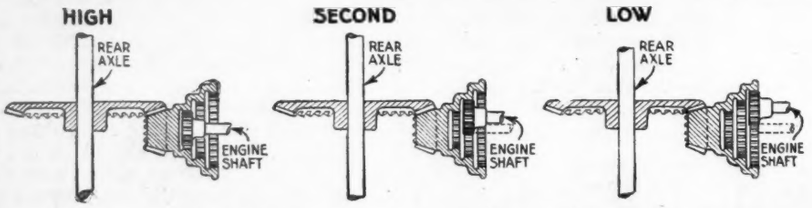
When the spur gear is meshed with the largest of these, the differential gears turn most slowly, thus giving low gear. When meshed with the smallest gear, the drive shaft is in direct line with the differential shaft, and as a result high speed is obtained.

An intermediate ring gear provides second speed. For reverse, the spur gear is moved forward and sideways until it meshes with a large external ring gear, causing the torque shaft to move opposite that of either internal connections.

Since only one bearing is required on the drive shaft, and five gears provide the necessary variations in speed, the friction is much less than in the case of common types that require four or more bearings and nine or 10 gears.



Above: The sliding gear transmission mechanism, showing long shaft that transmits power from the engine to a spur gear. Below: Relative positions of spur gear to internal gears for three speeds

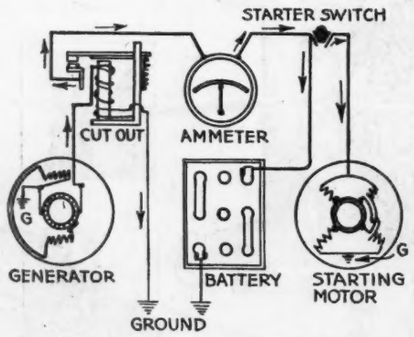


Know Your Car

The Generator and Its Circuits

YOU may know that the generator on your car supplies electricity for the ignition, starting and lighting systems; but do you know how it is connected with the rest of the circuit?

The generator itself is shunt wound, that is, a part of the electricity produced is shunted through the coils that provide the magnetized field through which the wires of the armature cut. The remainder of the electricity passes off on a wire to the cut-out. This cut-out serves to prevent the stored energy of the battery from dissipating itself by running back to the generator while the engine is stationary.

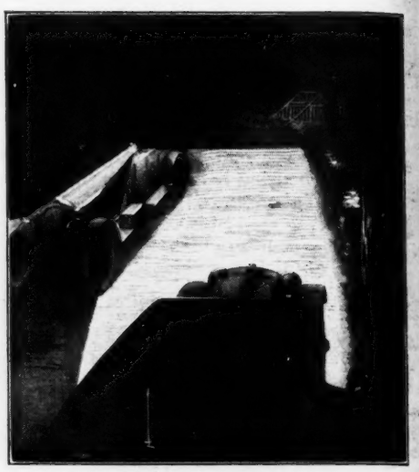


How generator fits into circuit

When the generator voltage has reached 6.5, which occurs when the car is traveling eight miles an hour in high gear, the cut-out points are brought together under the action of a temporary magnet. The current then can flow through the cut-out to the ammeter, which indicates that the battery is charging. Upon passing the ammeter, the circuit is broken, one part going to the battery and the other to the starter switch. The break is made at this point so that the current used to turn the starting motor will not pass through and burn out the ammeter. The starting motor requires from 120 to 250 amperes, and the usual ammeter is designed to carry only 30 amperes. Since the generator can produce only 22 amperes, it is necessary to utilize the stored energy of the battery for starting.

There are several complete circuits in the system. One terminal of the generator is grounded and one wire of the cut-out is grounded. Thus a complete circuit is formed whenever the generator operates, even though the cut-out points are separated. Then, too, the battery is grounded, forming a complete circuit—cut-out, ammeter, battery, and through ground back to generator.

One terminal of the starting motor is grounded to provide the return whenever the starter switch is thrown in.



New Sidelights for Autos Prevent Accidents

HOW many times would an automobile headlight providing a generous side ray have spared an accident along country roads at night?

Such a lamp has been invented. It throws a wide flood of illumination to the side of the car. Two of the lamps on an open or closed car can be moved at the will of the driver to throw their rays in any direction. They are controlled by a switch on the dash.

Efficient Tire Hand Pump Prevents Waste Effort

THIS newly devised tire pump, said to deliver more air with fewer strokes than any other hand pump on the market, has been perfected by a Kansas manufacturer.

The unique construction of the plunger and barrel is said to eliminate waste compression, to insure all the air from the barrel going into the tire at each stroke, and to make it impossible to pump oil into the tire.

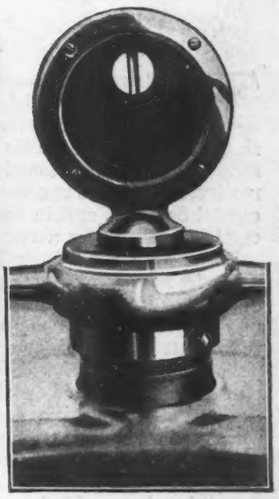
The absence of a screw cap on top of the barrel eliminates another feature objectionable to automobile drivers.

Inverse Duplex Set Will Double Amplification

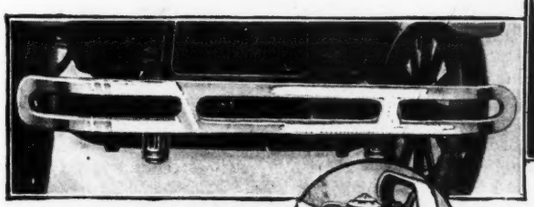
More Service and Convenience from Your Car

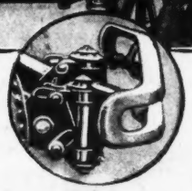
One of these gages on each tire will tell the air pressure at any minute, eliminating the use of a pocket gage and the removal of two tire caps

When in danger of striking a pedestrian, the driver of a car, simply by operating a lever, can drop this safety bumper instantly. As the bumper drops, a canvas fender unfolds to catch the pedestrian

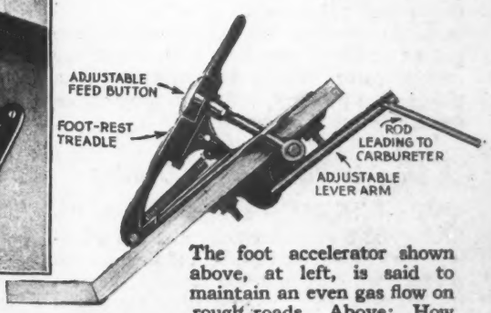


Inserting a locknut in a hole bored and threaded through the lower part of motormeter flange is said to obviate rotting washers, to keep the crossbar in line, and to baffle thieves

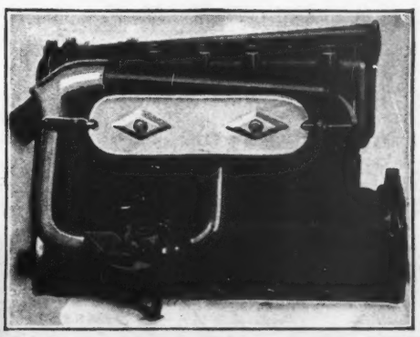




This flexible bumper, designed to absorb the shock of impact with yielding cord springs instead of meeting it with the rigidity of most bumpers, is said to minimize the consequences of slight collisions. Inset, one of the cord springs

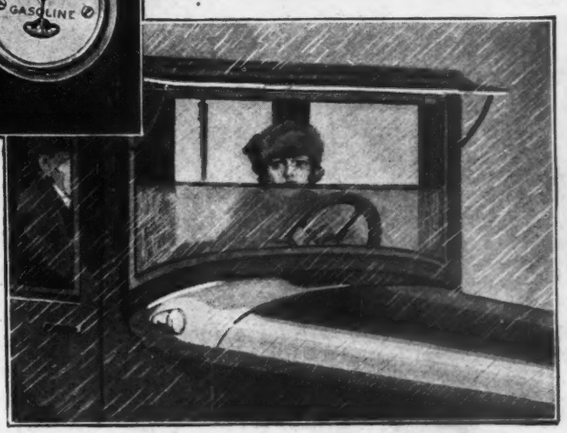


The foot accelerator shown above, at left, is said to maintain an even gas flow on rough roads. Above: How the pedal, which cannot be pushed down until the feed button is pressed, frictionally keeps the flow constant. Withdrawing the foot will retard the gasoline flow



A new hot spot for Ford manifolds (at left) absorbs heat from exhaust and directs it against the intake, into which inertia will throw all unvaporized fuel

Above, a gasoline dial gage for the instrument board. The positions of the float in the gas tank are conveyed electrically to the dial by the apparatus shown at the left



This automatic traveling cleaner rod, operated noiselessly by the motor's vacuum, clears the entire length of the windshield and so affords complete driving vision, no matter what the weather

With this jack, pressure on a pedal lifts a light car. The device keeps the hands clean and avoids many injuries

Inverse Duplex Set Will Double Amplification

By Joseph Calcaterra

Of POPULAR SCIENCE MONTHLY'S Radio Staff

THE Flewelling set described last month represents the highest development of the simpler radio circuits using a single vacuum tube. This month I am describing the construction of a more elaborate receiver, which uses two vacuum tubes and a crystal detector, and in tests has given exceptional results for a two-tube set.

Those who read Jack Binns' story on radio frequency and reflex circuits in the September issue will have little trouble in understanding the theory and operation of the circuit used in this set. It is, indeed, practically identical with the inverse duplex circuit explained in that article, with the exception that no condenser is used across the secondary winding of the tuning unit, a single rheostat controls the filament current of both tubes, and a battery switch has been added so that the A battery may be disconnected when the set is not in use.

This switch is important because it prevents running down the A battery uselessly through the potentiometer connected across the battery terminals.

The tuning unit is made by splitting the stator and rotor windings of a standard wooden variometer of the hollow shaft type having about 40 turns on both the stator and the rotor. The stator winding is then used as the primary, while the rotor winding is used as the secondary.

How to Obtain Closer Tuning

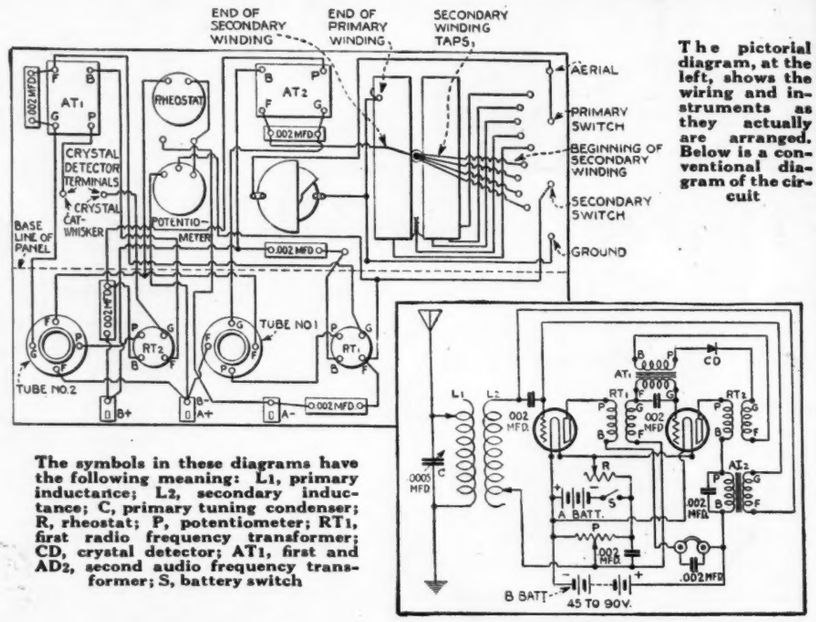
To provide closer tuning in both the primary and secondary circuits, the windings are tapped, six taps being taken on the primary winding and five taps on the secondary winding. This is done by disassembling the variometer, lifting the wire where a tap is to be taken, and drilling a small hole from that point to the outside of the stator or the inside of the rotor. The lead can then be inserted from the outside and the end carefully soldered to a bared portion of the winding. The wire is then forced back into place, care being taken that the tap has been made carefully so that it will not make contact with adjacent turns and short circuit them.

The right-hand half of the stator, as shown in the picture diagram, is divided according to the number of turns as nearly as possible into three equal sections, while the left-hand end is divided into two sections. The joint where the halves of the winding are soldered together is taken as another tap, so that, counting the outside ends, there will be six taps in all. The leads from these taps are connected as shown in the picture diagram, five of them going to the primary switch, while the sixth connects with the ground post.

The secondary winding is tapped so that four of the leads go through the hollow shaft to the secondary switch points, while the fifth is connected with the F terminal of audio transformer No. 2. The leads should be left long enough so that there is no tendency for the wires to act as springs and prevent the smooth operation of the rotor.

Provision should be made for a stop on the rotor shaft to prevent the rotor from being turned through more than one revolution. If this is not done, the leads from the secondary will soon be twisted and weakened, the insulation damaged, and the circuit rendered inoperative by short circuits. The wire used for the leads should be of the flexible variety, obtainable at practically any electrical supply store.

If the constructor does not care to use the tapped variometer type of tuning unit, he may use instead any standard or home-made type of variocoupler. In that case, the primary coil of the coupler can be tapped in the usual way by the use of a tens and a units switch and the variable condenser can be used across the secondary of the coupler instead of across the primary coil. Where this is done, however, it is desirable to use a Vernier condenser of three plates, if possible, across the primary winding in order to get close tuning.



The pictorial diagram, at the left, shows the wiring and instruments as they actually are arranged. Below is a conventional diagram of the circuit

The symbols in these diagrams have the following meaning: L1, primary inductance; L2, secondary inductance; C, primary tuning condenser; R, rheostat; P, potentiometer; RT1, first radio frequency transformer; CD, crystal detector; AT1, first and AD2, second audio frequency transformer; S, battery switch

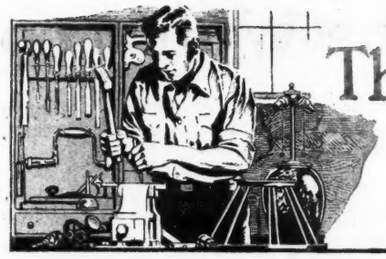
It is, of course, impossible to give exact dimensions regarding the placing of the parts on the panel and in the cabinet, as these dimensions depend considerably on the type and size of the parts used in making the set. In making the set illustrated, however, a 7 by 18 in. panel was used, so that if you use a panel of this size, with a cabinet of corresponding proportions, you will have no difficulty in placing your instruments in the same general positions as those shown in the photograph. In this set the three 1½-volt batteries for the filament current and four small B batteries go inside the cabinet. This makes a compact, self-contained receiver.

The operation is very simple. After closing the battery switch, the rheostat is adjusted so that the tubes are burning fairly brightly. By varying the adjustment of the tuning elements of the set and testing various spots on the crystal with the catwhisker, a spot will soon be found that is sensitive and brings in one of the broadcasting stations that happens to be "on the air" at the time. Once this adjustment is obtained, no further attention to the crystal is necessary and it can be left at that adjustment until such time as it should be jarred accidentally from its position.

Once the sensitive spot has been located, any desired station can be brought in by the usual manipulation of the tuning elements and by a proper adjustment of the potentiometer. Then the rheostat can be reset so that the current flowing through the filament is as low as possibly consistent with good results.

If clear reception is not obtained after you have made all possible adjustments, you may try grounding the catwhisker side of the crystal detector circuit. This expedient will often bring in the station, but it should not be tried unless the set does not respond to the other adjustments.

The set before being placed in cabinet (above) and front panel (at left)



The Home Workshop

Arthur Wakeling, Editor

How to Rebuild a Broken-Down Car

By Ray F. Kuns

Principal, Automotive Trade School, Cincinnati, Ohio

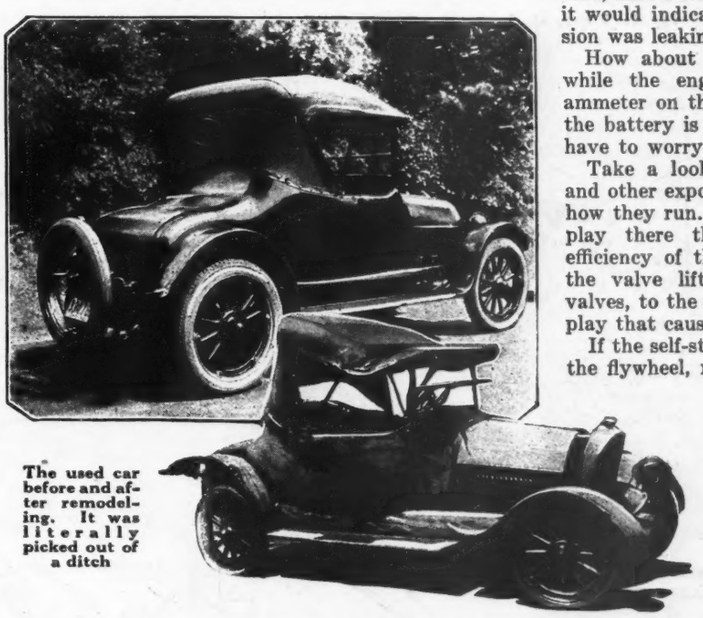
THIS is the first of a series of three articles on how to remodel a used car. Next month Mr. Kuns will tell how to overhaul the rear end, the transmission, and clutch.

NO MATTER how little money he has to spend, the man who is mechanically minded and has a genuine enthusiasm for automobiles never need be without a smoothly running and good looking car.

What can be done in remodeling a broken down car is strikingly illustrated at the right. The car shown is a 1918 model of a roadster six, built by a good manufacturer. Although subjected to hard use and some abuse, it was still in fair running condition when it went into the ditch and was reduced to the unsightly wreck of the lower illustration. It was bought for $75, which was high, if anything, and remodeled at a cost for materials of $135.15. This included paint, top, and tires.

This was not a freak performance; any wide-awake mechanic interested in automobiles can do as well. In fact, it is often possible to buy a car for less and put it in running condition at a smaller expenditure. It is even easier, however, to pay as much or more for a used car and never be able to make anything out of the machine.

Half the battle in remodeling a used car is, indeed, to pick out one that can be put into good shape easily at low cost. To make a wise purchase is of primary importance, and nothing but disappointment awaits the mechanic if he does not choose a car strictly on the basis of the repairs necessary to reconstruct it.

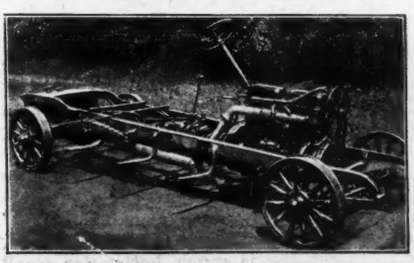


The used car before and after remodeling. It was literally picked out of a ditch

Year after year hundreds of thousands of used motor cars are placed upon the market, but only a certain proportion of them are worth buying for remodeling. Special precautions and unusual methods must be taken in selecting a car.

First of all, look at a number of cars before deciding to buy. What you must look for is a solid frame, an engine having no scored cylinders, a starter that works, generator that shows signs of being healthy, bearings that are not too noisy; in other words, a good power plant.

Start your search by inquiring among friends whether they know of a used car for sale. Then, too, it would be well to make the round of the secondhand dealers. While their cars usually are fixed up to strike the eye and may have engines of doubtful quality, one can sometimes obtain a good one. At any rate, you will get an idea of the average prices.



The chassis stripped and ready for a thorough cleaning

The question of size plays an important part in the price of secondhand cars. There is a greater market for the smaller ones and hence the price is proportionately less for the larger models. Furthermore, one should purchase a make of car for which repair parts can readily be obtained. Obsolete makes are very cheap, but don't be tricked into buying one you cannot repair because of the difficulty of obtaining replacements.

Looking Over the Mechanism

Having found a car that comes within the price range and will answer your needs as far as size is concerned, take up the all-important consideration of the mechanism and the possibilities of repairing it.

First, are the cylinders and piston rings in good condition? Leaving off the ignition, turn over the engine very slowly with the hand crank. Note whether or not the compression reaction in all cylinders seems to be about the same. In a four-cylinder engine, if three are strong and the fourth is weak, try to learn which one is defective.

If there is a hissing noise as the compression escapes, it may mean a scored cylinder or bad piston rings. In that case, ask permission to remove the head and inspect the cylinders. If a cylinder is scored, leave the car alone; but if only the piston rings are worn, these can readily be replaced.

Another way would be to have the owner run the engine for you. If there is a hissing sound emerging from the breather tube, take a look at the cylinders, for it would indicate that the compression was leaking into the crankcase.

How about the generator? If, while the engine is running, the ammeter on the dash indicates that the battery is charging, you do not have to worry about the generator.

Take a look at the pump shaft and other exposed drive parts to see how they run. There may be some play there that will impair the efficiency of the engine. Listen to the valve lifters and, if overhead valves, to the rocker arms. Is there play that causes rattling?

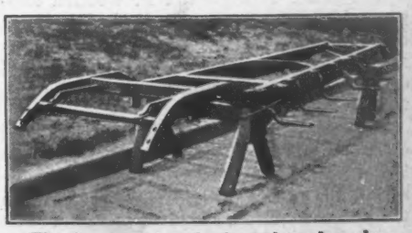
If the self-starter is operated from the flywheel, remove the inspection plate and take a look at the teeth. Very often these become ground down through long operation and poor lubrication and eventually such worn teeth will break and leave you without a starter.

How about the radiator? See if it holds water and whether or not the pump throws water into the top tank when the engine is speeded up. If it does not flow down through the radiator core properly, it will fill the upper tank and overflow, indicating that the core is stopped and may have to be renewed.

And how are you going to determine the amount of play in the transmission system? Just jack up one of the rear wheels, throw the gearshift into high with the engines stationary and turn the jacked-up wheel as far as it will go. If the wheel does not rock more than 4 or 5 in., the parts probably are good. If the wheel rocks a quarter turn, inspect the universals and propeller shaft and see if you can locate the play there.

There should not be too much play in the

(*Turn to page 114*)



The frame stripped, cleaned, and ready for inspection

Making the Most of Your Home Workshop

WHEN polishing with an emery cloth, the holder shown in Fig. 1 is more satisfactory than a flat file.

The cloth is cut the right width and the ends are folded and slipped into the diagonal slots. The abrasive is then tightened by screwing the windnut.—G. A. L.

IN THE middle of a job, when the need for a surface gage came up unexpectedly and no gage was available, the serviceable substitute illustrated in Fig. 2 was quickly put together. The parts used are a 1½-in. brass pulley with a ¼-in. hole, a length of ¼-in. steel rod, an old brass screw with a large hexagonal head, a piece of ⅛-in. tool steel, and two thumbscrews with milled heads.

One end of the ¼-in. rod was pressed into the pulley and the other was drilled, so that the threaded part of the brass screw could be passed through. The milled nut holds the screw in any position in which it is turned. Through the head of the large screw was drilled, from side to side, a hole to take the ⅛-in. rod used as the scriber. Another hole was drilled to meet it and tapped for a 6/32 machine screw to clamp the scriber in place, bending one point before tempering.—H. G.

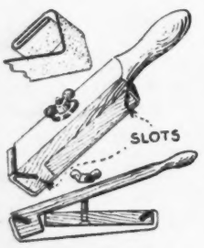


Fig. 1. Emery cloth holder

Fig. 2. Surface gage

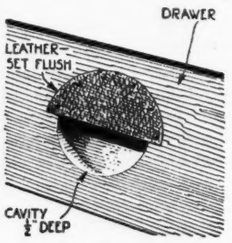


Fig. 3. Drawer handle

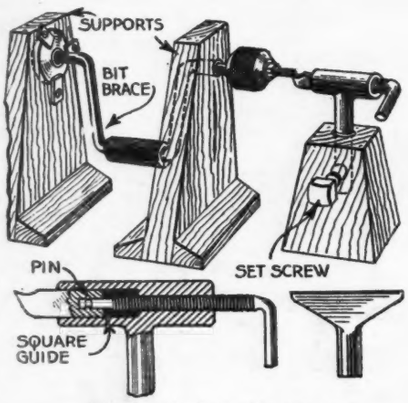


Fig. 4. Bit brace for turning

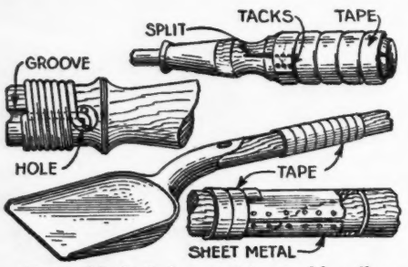


Fig. 5. Methods for repairing tool handles

FOR workbench drawers and other drawers that are better for having flush handles, and where appearances are not important, leather serves very well for the handles. Simply cut a cavity about 3 in. in diameter with an expansion bit and tack a semicircle of leather over the upper half of the hole (Fig. 3). If the edges of the leather are inlaid in the wood, the job will be all the neater.—THOMAS W. BENSON, Philadelphia, Pa.

IN A home workshop where the tool equipment is limited, the bit brace may be used for simple turning, coil and spring winding, and other work that requires slow, heavy, positive rotation.

The brace is mounted in wooden supports, high enough to permit the handle to be turned freely, as shown in Fig. 4. A simple tool rest can then be made, and, if desired, a clamp for holding and feeding a tool against the work.

Two cones arranged to slide on a rod that can be gripped in the bit chuck, will serve to hold various sizes of cylindrical forms for radio coils. With other fixtures that can be devised as required, the bit brace will act as a turning machine for the occasional job that otherwise cannot easily be done with hand tools.—L. A. G.

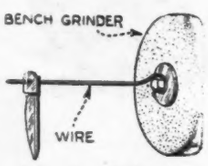


Fig. 6. Enlarging small holes

Fig. 7. Screw holder

TOOL handles that are cracked or fractured can often be repaired so as to give good service, especially if the damage is checked in time. A split file or chisel handle can be reinforced by a twisted ferrule of soft wire. One end of the wire is laid in a groove cut in the wood and, when the winding is completed, twisted with the other end, as shown in Fig. 5. The loose wire is then cut off, and the butt forced down into a drilled hole and filed off smooth.

Every one tapes a screwdriver handle, but the tape persistently comes loose unless the end of the last turn is folded and fastened with very small tacks.

A shovel or even a pick handle that is split may often be repaired. File down the wood for a distance of 3 in. on each side of the split to a diameter of ⅛ in. less than that of the handle and tack a sheet of brass or other metal tightly over the cracked part. Wind tape on top, extending it beyond the ends, to make as smooth a reinforcement as possible.—JOE V. ROMIG.

AN ORDINARY hand grinder can be used in the home workshop for enlarging a small hole in tempered steel (Fig. 6). A length of iron wire of a diameter that will just slip through the hole, is bent into a ring at one end. This eye then is turned at right angles so that it can be fastened to the grinder spindle by means of the wheel locknut. Valve grinding compound is applied to the wire, and the piece to be reamed is slid back and forth along the wire while the grinder is being turned.—M. C. METZER, Silver Creek, Neb.

A HOLDER made of soft wire, as shown in Fig. 7, is a time-saver in starting small screws in tapped holes that are difficult to reach.

The head of the screw is placed between the two loops and gripped by drawing back the sliding cross piece.—A. C. L.

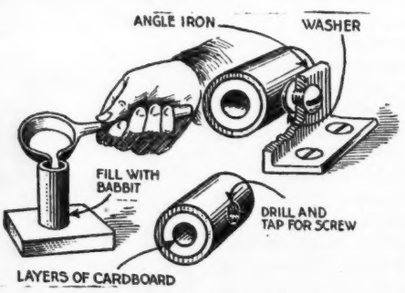


Fig. 8. Small universal bearings

SMALL machine bearings that can be mounted on surfaces of almost any shape and that are adapted to all sorts of positions, can be made quickly from ordinary gas- or water-pipe. Obtain pipe about ½ in. larger than the shafting for which the bearing is to be used, and saw off pieces 1 in. long or longer. Fill each with babbitt, place it in a lathe, face it off and drill for the shaft. Next, drill and tap a 3/16- or ¼-in. hole, as shown in Fig. 8, and mount the bearing on a short length of angle iron. Many combinations of bearings and angle irons are possible, and the construction is strong enough for light work.—C. F. KLINGER, Pittsburgh, Pa.

HARD fiber is exasperating stuff to work on the lathe, chiefly because it so quickly spoils the cutting edge of a tool. Grind the cutting tools as for working brass, but with all the angles somewhat less acute, and see that they are as hard as fire and water will make them. The speed of the work should be quite slow as compared with that used for turning brass. Particular pains should be taken to keep the point of the tool always cutting; do not allow it to scrape along the surface without taking a bite, for it will then act as a grinder and rapidly wear off the edge. Do not take too heavy a cut, although that is better than to scrape without cutting. No matter how hard the tool may be, it will require frequent sharpening.—H. C.

FOR filing a finish on a small flat surface, one of the best ways is to lay the file flat on the bench and move the job over it instead of attempting to keep the file in one place while moving it across the work held in a vise.

With but little care a very true surface can be produced. An excellent type of file for this is what is known as an "equaling" or "parallel" file, which has no taper. A smooth-cut file is much better for small work than the coarser cut files.—L. P.

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How to Build Serviceable Tables Quickly

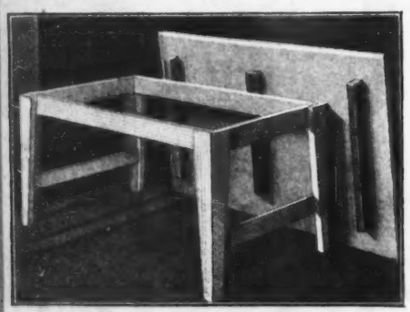
By Leslie W. Lyon

AMATEUR woodworkers who have had little experience or cannot spend much time in their home workshops, often do not care to attempt making mortise and tenon joints, or even plain doweled joints. These workers will find useful the type of table construction shown in the accompanying illustrations.

This method of joining table frames was first suggested to me by an old mechanic and since then I have used it for making all sorts of tables—library tables, large dining tables for porch use, writing tables for the summer camp, and, finally, a playroom table for the nursery.

The advantages of the construction are that the entire table is made from ⅝, ¾, or ⅞-in. stock, that only the simplest screw joints are used, that the table can be knocked flat in five minutes for shipment or storage, that an ordinary carpenter can build one from plain lumber within two

A library table with a lower shelf made of 7/8-in. stock throughout

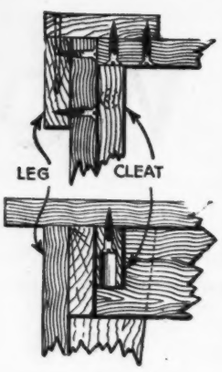


The general table construction is shown above and the joint details at the right

hours, and that the finished table is neat, strong, and durable.

Each leg is made of two pieces nailed together with finishing nails. Holes should be drilled for the nails, especially if hard wood is used, and, if a thoroughly durable job is desired, the joints should be coated with thin glue before nailing. A nail is first put in the center of the leg and then one or more nails at each end driven at a slight angle toward the center. The rails are then attached to the legs with screws driven in from the inside.

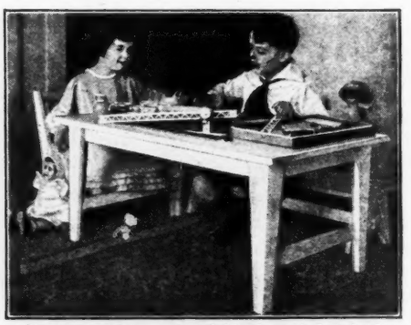
If the table is a large one, it is advisable to connect the lower rails with a shelf. This shelf may simply be screwed to the top edges of the lower rails or to cleats that have previously been screwed to the inside of the rails. A neater method is to mortise and tenon the shelf into the end rail, as shown in the center illustration above.



The boards forming the top are held together with three cleats. I have never fastened the tops directly to any of the tables, but merely have placed the end cleats edgewise in such a position that they fit just inside the top end rails of the table. In fastening the cleats to the top, I use large round-head screws, first boring holes edgewise into the cleats to let the heads of the screws in about an inch and then boring holes for the screws the rest of the way of such a size that each screw will have a little play. This allows for any expansion or contraction of the boards. A single screw run through the cleat and into the end rail at each corner will hold the top in place, if thought necessary. It is, of course, imperative to use screws and not nails for all the joints except those connecting the long, tapered boards used as leg members.

Any type of finish may be used. The library table illustrated is oak, stained, shellacked, and waxed. The play table is birch, carefully sanded and finished with two coats of flat white paint and ivory enamel, the last coat being rubbed with finely powdered pumice stone and water.

The porch dining table, not shown, was painted white on top with bright green legs and frame. This table and several ordinary kitchen chairs painted in the same color combination, make an attractive summery looking luncheon set. The table itself, although about 6 ft. long, is taken apart at the end of the summer, and stored very compactly in the attic.



A play table made of birch and finished in ivory enamel rubbed smooth with pumice stone

Magnet Changes Telephone into Sensitive Loudspeaker

By George A. Luers

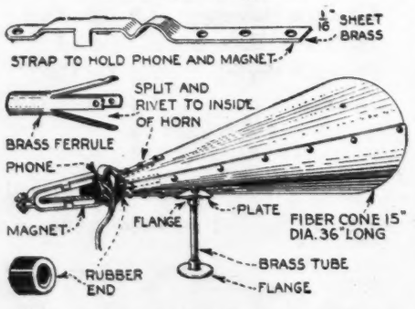
Mechanical Engineer

BY ADDING a powerful permanent magnet to an ordinary homemade loudspeaker, it can be made sufficiently sensitive to operate even with a crystal set, provided the receiver is quite close to a broadcasting station. The same loudspeaker, with a vacuum tube set or a combination crystal and vacuum tube receiver, gives exceptional results.

Most radio experts will be inclined to challenge the possibility of a crystal set's operating a loudspeaker. If you are interested, however, it will cost you little to make the experiment for yourself.

Music from the Arlington station at Radio, Va., five miles away, came in so well through a crystal set and the loudspeaker illustrated, that it could be heard from any position in a room about 9 ft. square. It was low but audible. Two local Washington, D. C., broadcasting stations, both nearer than the Arlington station, also were heard. A good quality commercial telephone with a metal diaphragm was used in the loudspeaker, and the set was of an ordinary variocoupler type.

The loudspeaker was also tested with a Baldwin mica diaphragm telephone, and the magnet added considerably to the strength of signals in both cases. In conjunction with the single tube set, using the same simple variocoupler, the music was clearly and distinctly audible in adjacent rooms, and provided music loud enough for dancing.



This unique loudspeaker is merely a permanent magnet, an ordinary radio telephone, and a fiber horn combined

The horn of the loudspeaker is made of hard red fiber board. For satisfactory results, the material must be quite stiff. It is about 1/16 in. thick, 3 ft. long and 15 in. in diameter at the large end. The joint is fastened with paper fasteners or clinch rivets, preferably the latter. These also are used to fasten the horn to the bracket.

The bracket is a short length of brass tube with flanges at both ends. One flange is fastened to the baseboard or the table, and the other is attached to a thin brass or aluminum plate, which is bent to form a cradle for the horn and riveted to it. The fixture should be free to turn in any direction around its vertical axis.

At the small end of the horn is a brass ferrule or piece of tubing, split, drilled, and attached with rivets. Two brass clamps, bent as shown, are also fastened to the horn to hold the receiver in place. A piece of rubber tubing is drawn over the end of the ferrule so as to bear tightly against the telephone when it is in position.

At the rear of the telephone is located the magnet, which is gripped by the brass straps and placed so that the poles are against the back of the phone. The magnet can be one from an old magneto, or of the kind obtainable at any automobile supply store for use on auto flywheels.

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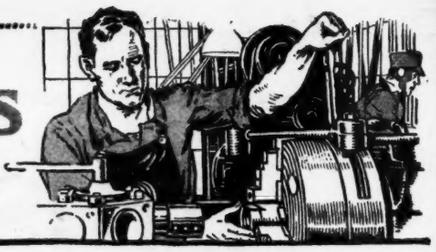


Improved Toolpost Speeds Up Lathe Work

By H. L. Wheeler
Machine Shop Foreman

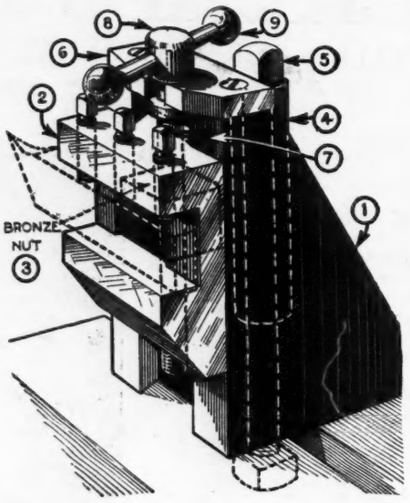
THOROUGHLY tested for a long period by the writer, the lathe toolpost illustrated has demonstrated unmistakably that it has several advantages over the conventional type of toolpost found on the majority of lathes. It has stood up under heavy cuts very much better than the single screw type of toolpost. Even more important, the tool may be swung quickly to any angle and lifted or lowered at will with the precision of a micrometer and without altering the tool setting.

The tool has a better support than ordinarily and is held more rigidly because three binding screws are used. It also may be removed for grinding and replaced in practically the same position. None of the usual puttering around with hammer or wrench is necessary to set the tool back in position. There are no loose pieces when for any reason the toolpost is removed from the lathe; there is nothing to be lost or mislaid. Furthermore, the toolpost may be used for turning and boring either right- or left-hand with equal convenience.

In almost every machine shop one well known type of commercial boring bar is well liked, but these bars often cannot be used because the lathe toolposts either have too much or not enough side clearance for the space between the bar and holder. With this improved toolpost, however, there is no difficulty in using this type of bar and any size bar may be used.

An additional advantage is that the toolpost may be used as a milling fixture for small jobs, and this feature should find great favor in small shops and garages.

The body (1) is made of iron, although steel may be used, if desired. It should be cast in rectangular form and planed to the outside dimensions. The slope at the back should not be planed until the hole for the clamping bolt (5) and spacer (4) has been drilled, as it would be a rather difficult operation to machine this hole after the angle has been planed.



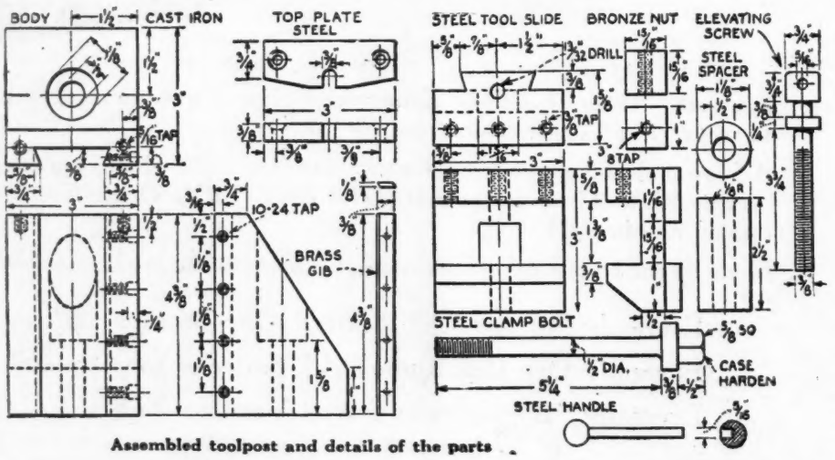
The tool slide (2) is made of mild machine steel and should be casehardened. This design shows tapped holes for three binding screws, although I believe two binding screws would be quite sufficient. The dovetail should be planed carefully and fitted to its corresponding seat in the body.

The nut (3) is made of bronze or brass and is merely a cube shaped piece nicely fitted in the square hole in the tool slide. The hole for the elevating screw (8) is located in the assembly after fitting by using a body size drill to spot the hole and then using the proper size tap drill. The hole drilled through the tool slide should be at least 1-32 in. larger than the screw, so that there will be no chance of the screws binding.

The design and dimensions of the topplate (6), the gib (7), and the handle (9) are made clear in the details. It should be noted, however, that in making the binding screw or clamp bolt a 5-32-in. fillet is used at the shoulder. I always put a fillet in places like that when possible because it gives additional strength where needed. The clamp bolt and the steel spacer should be casehardened.

The dimensions are, of course, suited only to one size lathe and necessarily will have to be changed to suit the lathe on which the tool holder is used.

The binding screws and all threads are standard.



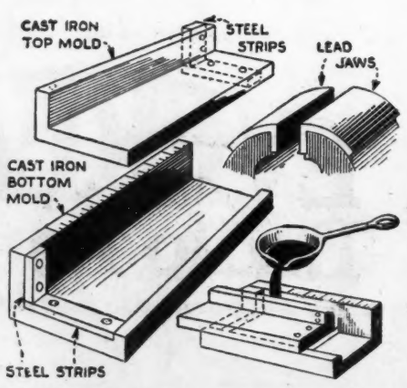
Assembled toolpost and details of the parts

Adjustable Mold Aids in Casting Vise Jaws

IN LARGE machine shops it is frequently necessary to cast lead vise jaws to fit vises of a number of different makes and sizes.

This work is greatly simplified by using the adjustable mold illustrated.

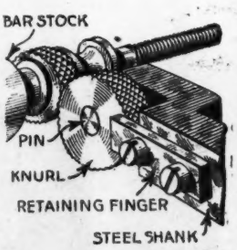
A convenient size for the bottom mold is 4¾ by 8 in. over all and for the top mold 3¾ by 8 in., the cast iron being ⅝ in. thick. A soft steel strip, ¼ by 1 by 3½ in., is fitted into the recess of the bottom mold, and a similar strip, ⅜ by 1 by 1½ in., is riveted to the back. Corresponding strips are attached to the opposite end of the upper mold, and the edges are tapered 2 degrees where necessary for clearance. Smoke the mold before using, and make the jaws of lead, not babbitt. Note the scale on back of bottom mold.—H. S. L.



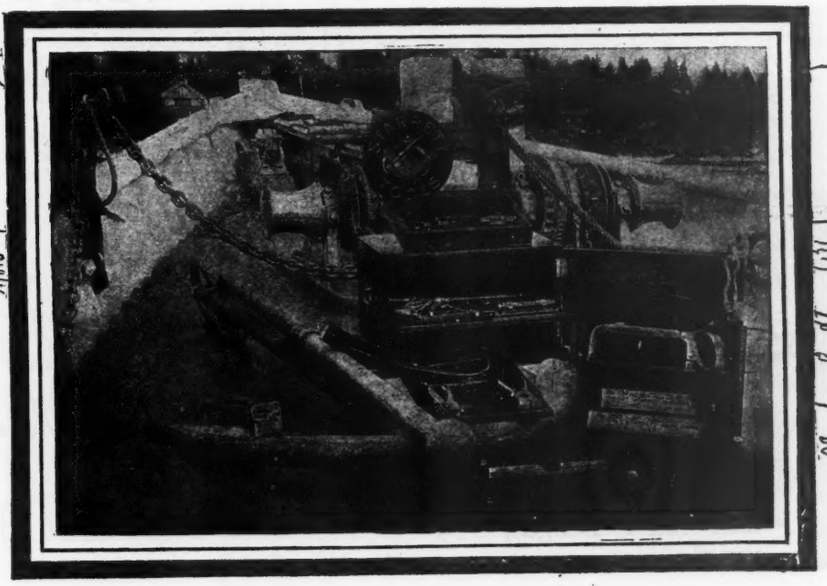
How the mold is made and used

"Close-Up" Knurling Tool

THE offset construction of this knurling tool allows the knurl to work right up against the shoulder. This is an advantage when the work is such that the yoke-like arms of the common type of knurl holder are in the way. The steel shank is machined as shown and fitted with a retaining finger. The knurl pin is hardened tool steel and a driving fit in the tool shank. Casehardening the shank will prevent wear.-J.R.



The handy man's drill



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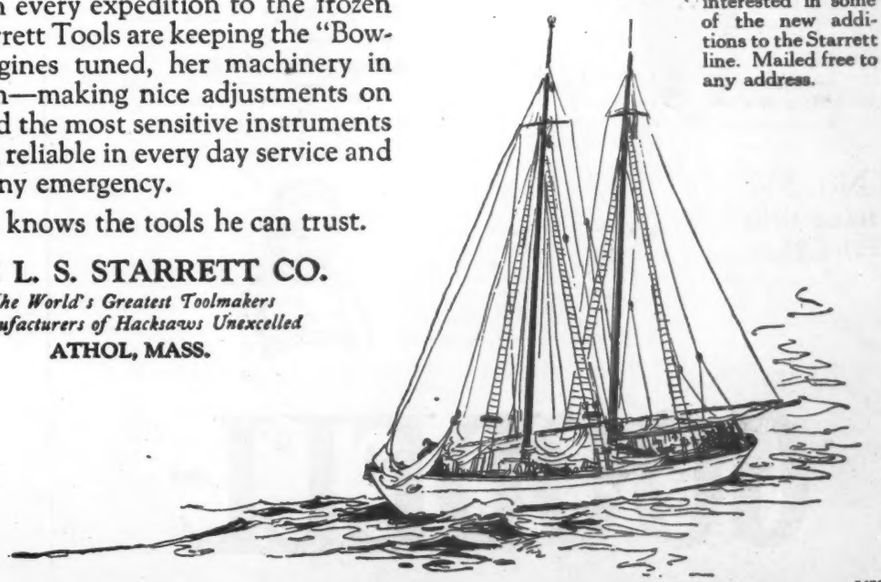

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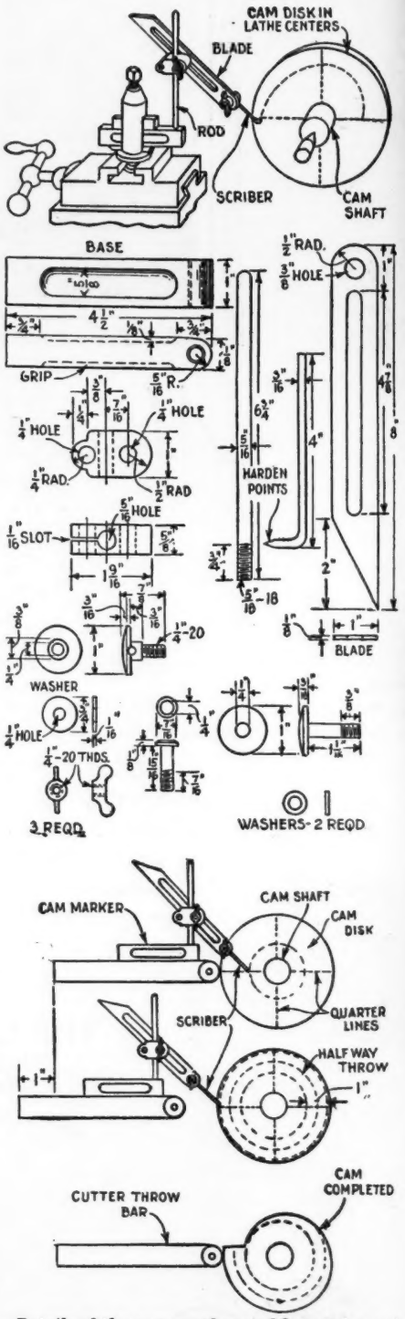
Machinist's Marker Saves Time in Laying Out Cams

FOR the mechanic who has to lay out cams, the tool illustrated is a time saver. It was designed by Mr. William Hanson, a toolroom foreman, and is constantly proving its value in actual use.

The tool can be held in the toolpost of a lathe and the cam disk held between its centers, or it can be placed on the cutter

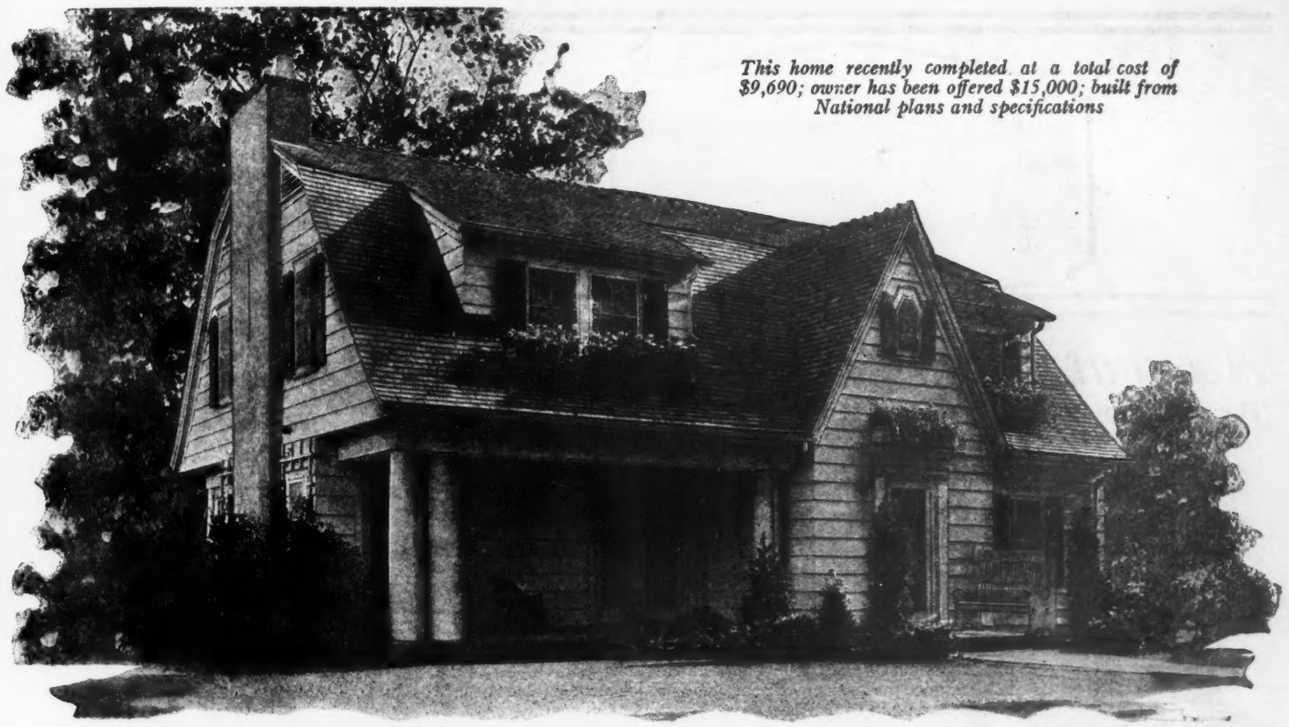


Details of the cam marker and how it is used

throw bar and the cam disk held in its place on the machine.

All parts are machine steel except the rod and scriber, which are drill rod. The base can be casehardened if desired.

The tool can be used as a surface gage, a holder for indicator, a height gage, and a bevel. It is top heavy for height gage work but a special wide base can be supplied or the rod may be screwed to a tapped hole in a short, wide parallel.—H. L.



This home recently completed at a total cost of $9,690; owner has been offered $15,000; built from National plans and specifications

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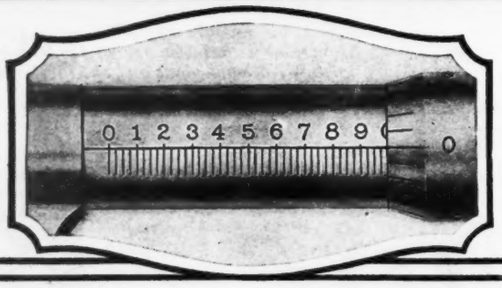

Accurate Clean Cut Graduations

The second point of superiority of BROWN & SHARPE Micrometers

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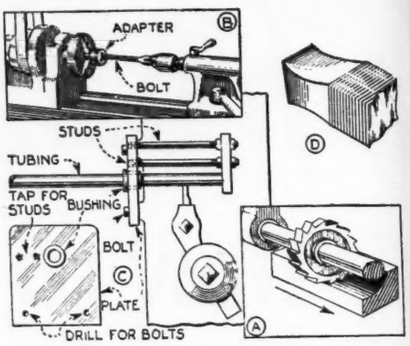
Some Machine Shop Kinks I Have Found Useful

By H. W. Bente

IN MILLING down a steel block recently, I found the ⅝ by 6 in. side cutter I was using—the only one available—chattered very much in taking heavy cuts. By working the cutter sideways against the work, as at *A*, I was able to proceed much faster and overcome the chattering entirely. Care must be used, of course, not to overcrowd the work and break the cutter, but as an emergency trick, this is entirely satisfactory, especially in a small shop where a machinist is often called upon to do a greater variety of work than he is properly equipped for.

The reverse belt of a lathe is invaluable at times. For instance, I had about fifty



A milling kink (A), using the reverse belt on a lathe in threading (B), cutting off bushings from tube stock (C), and a lathe roughing tool (D)

4-in. rods to thread, and only a single die to work with. By making an adapter to hold the die and placing it in the spindle of the lathe, as at *B*, holding the other end of the bolt in the tailstock, I ran the lathe the right way to thread and used the reverse to back it out again.

Another "kink" that has worked well is the method of cutting off small bushings from brass tube stock, illustrated at *C*. On most lathes will be found two tapped holes for the so-called follow-up steady rest. They are usually on the side of the cross carriage nearest the spindle. In this case they were used for attaching a cast iron plate having a hole bored in it in line with the hole in the lathe spindle. To accommodate several sizes of stocks, several bushings were made with holes of the correct sizes. Each of these bushing adapters has a shoulder that comes up solidly against the plate to prevent the tubing from pushing it through the plate. On the cut-off side of the plate are two studs holding a short piece of flat cold rolled stock to serve as a guide for the correct length.

For roughing work on a lathe, I have a method of grinding the tools that would, I believe, be hard to beat. It requires less power than usual, and I have often been able to take a cut the full width of the tool running on the open belt. The tool is ground straight across the face, as shown at *D*, with the amount of clearance depending upon the size of the work at hand. It has a lip at the top to cause the chips to curl up and roll away from the tool, thus reducing the amount of friction.

A little suggestion that comes to my mind is in regard to dressing an emery wheel for putting a fine finish on a tool: Hold an ordinary oilstone against the wheel after the wheel has been dressed with the regular emery wheel dresser.

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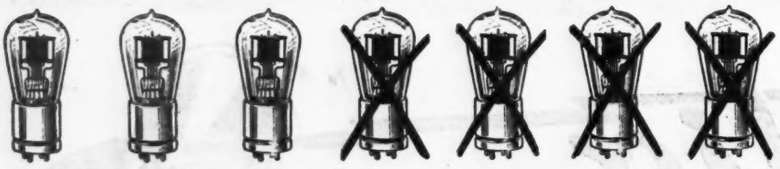

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For all except the most distant stations, outdoor antenna can be dispensed with, an inside aerial serving equally well. Wet batteries, likewise, are no longer essential, low current consumption enabling satisfactory use of dry cells.

Accounting in large measure for the amazing efficiency of this circuit, and guaranteeing its successful operation, are Erla synchronized radio and audio frequency transformers. For the first time, perfect inter-relation and co-ordination between transformers has been secured in reflex work, producing unequaled amplification without distortion.

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Detailed working diagrams and descriptions of the Erla Triplex and other advanced Erla reflex circuits are included in Erla Bulletin No. 14, obtainable gratis from leading radio dealers. Or, if your dealer should be unable to supply you, write us direct, giving your dealer's name.

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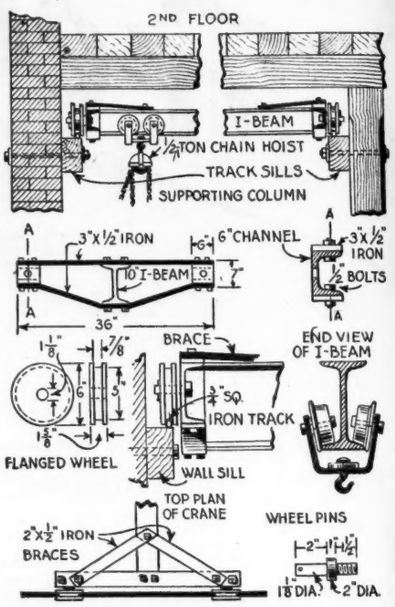
How to Build an I-Beam Garage Crane

THE universal I-beam garage crane illustrated can be built at minimum expense in any garage repair shop. It is fabricated mainly of standard steel or iron shapes, and most of the work consists merely of drilling and bolting the parts together.

Wall sills are bolted to one wall and to the opposite wall, posts or other supports, as shown. These should be sound 4 by 6 in. yellow pine or other strong wood, and supported with bolts every 3 ft. along the wall. Tracks of ¾-in. square iron are fastened to these sills with countersunk wood screws spaced 12 in. apart.

The crane proper is a section of 10 inch I-beam to which traveling ends are attached, as indicated. The beam forms the bridge and trolley track for the chain hoist.



How the parts of the track and trolley are made and the way they are assembled

The end carriages are ½ by 3-in. flat iron or steel, the top piece being straight and the lower piece bent to the form shown. At each end these pieces are bolted to a 6-in. length of 6-in. channel iron and the channels are drilled to take the pulley shafts, which are turned of round, cold rolled steel. The flanges butt against the channel iron and are held in place by a nut on the rear.

The wheels are cast iron, machined with ⅛-in. grooves to fit freely on the ¾-in. track. Oil holes are drilled for lubricating the bearings. Braces of ½ by 2-in. iron keep the end carriages firm and square. The trolley can either be purchased already assembled or made up in the shop along the lines shown.—J. R.

Estimating Weight of Castings

A HANDY method for a foundry to determine what quantity of steel or brass to pour to complete any number of castings is to stamp the weight of the casting on the pattern. Where this is not practical, the same result can be obtained by figuring that a steel casting weighs 16 times as much as its pattern in white pine, and a brass casting 18 times. From 10 to 20 per cent extra should be allowed for fins and risers.—F. M. S.

No wireless receiving set complete without

New Magnavox Combination Set

A2-R insures convenient and perfect Radio reproduction. Designed especially to meet the requirements of receiving sets used in the home.

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IT has been the dream of every Radio user to own in one unit a Power Amplifier and electro-dynamic Reproducer, thus insuring perfect Radio reproduction.

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R2 with 18-inch curvex horn	$60.00
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World pioneers in the development and manufacture of sound amplifying apparatus

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3-bulb Regenerative Receiving Set. Piano finish mahogany cabinet. Amplifier switch. Concealed binding posts. Armstrong circuit, licensed under Patent No. 1,113,149. Price $75, without bulbs, batteries or loud speakers. Ask for special circular No. 19B, describing this set.

Let the day's troubles sink with the sun

THEN turn to your Tuska Radio, and be whisked around the world. A touch of the dials, and you are in Davenport. A slight movement brings you to Philadelphia to hear the majestic music of the greatest organ. Or *anywhere* you please to go. In those precious hours between work and sleep, you live in Radio Fairyland, where you are master of distance and ruler of a host of entertainers.

Will you give your family the pleasure of Tuska Radio, which educates, soothes, amuses, and takes you traveling inexpensively? Here is the receiver that annihilates miles; bringing in music and voices sweetly, clearly and undistorted. It is the ideal set for busy people who want the thrills of radio without the tinkering.

For 12 years, Tuska Radio has been famous for advanced design and painstaking New England workmanship. The Tuska receiving set of today is not only up-to-date; it will still be serviceable in five years.

THE C. D. TUSKA CO.
Hartford, Conn.

TUSKA TRADE MARK REG. U.S. PAT. OFF. RADIO

TUSKA RADIO

Time-Tested Tricks in Casting Babbitt Bearings

By Joe V. Romig
Machine Tool Designer and Builder

WHILE all machinists are more or less familiar with the use of Babbitt metal, there are, nevertheless, many tricks that make the work easier.

Babbitt metal is ordinarily a combination of three or more of the following metals: tin, lead, bismuth, antimony, and copper. Those mixtures with the largest content of tin usually cost the most.

If you wish to mix your own, place a ladle on a good fresh coal fire and throw into it the metal having the highest melting point. When this has melted, add the next highest, and so on until all are melted and fused together. Stir well with a wooden paddle or iron rod before pouring into the pig molds to cool. If copper is to be added to the mixture, it must be melted in a small separate crucible, and poured into the batch and stirred well just before removing the Babbitt metal from the fire. In order not to lose any of the high priced metals through oxidization, the metal

Goggles and a handy lump of clay will reduce the danger of accidental burns

should not be heated too much or be kept at a high heat too long. If, for any reason, a ladle must be kept going for the casting of many small pieces, the top surface of the molten metal should be protected by a sifting of finely pulverized charcoal dust. This will keep off the air and can be brushed or skimmed aside readily when pouring.

Before pouring a bearing, always stir the metal well. Invariably copper will rise to the top, and this valuable metal usually is lost when an inexperienced mechanic does the pouring. Use a wooden paddle or iron bar to run or douse the top dross beneath the surface, as that is the only way in which the copper can be saved. Rather than skim off the dross, push it to one side; when you have finished pouring, this same coating again will cover the surface and prevent a new coating from forming.

To make Babbitt metal pour freely, throw in a small amount of powdered rosin, and stir well, immediately before pouring. Rosin will also keep down the gas formation and should always be used when pouring into a moist or sweating bearing.

Excessive heat "kills" Babbitt metal and makes it harsh and brittle. A good test is to pour when the metal is hot enough to ignite a dry pine stick or sliver. This temperature is the best except when pouring into extensive, shallow cavities or deep and intricate recesses.

(*Turn to page 90*)

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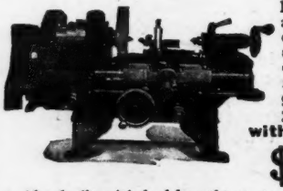
Most efficient machine tool you can have in home workshop, repair shop or garage too. Turns out, with 1000th-inch accuracy, all small wood and metal parts that other lathes will. *Experimenters, inventors, mechanics* enthusiastic over it. Completely equipped; auto. safety devices; semi-quick change gear.



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$245

Also built with bed lengths up to 5 feet. Made in 11-inch swing size too, at slightly higher price.

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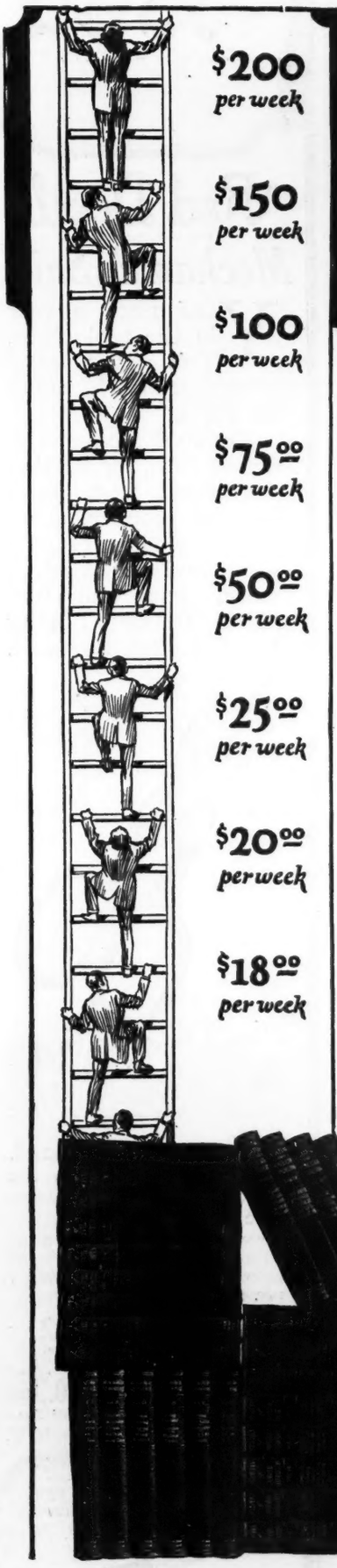
INTRODUCING



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The Millers Falls workmen are radio fans, too. They have just produced a radio hand drill—No. 85—so good that no one can afford to be without it—so reasonably priced that every one can easily afford to buy it.

This drill has ¼-inch chuck capacity and takes all twist drills used in radio work. Black enamel frame—gear enameled red. See it at your hardware dealer's. You'll say it's a beauty.

MILLERS FALLS COMPANY
Millers Falls, Mass.
Manufacturers of Carpenters' Tools, Hack Saws and Automobile Tools.

MILLERS FALLS TOOLS
SINCE 1868

Tricks in Babbitting

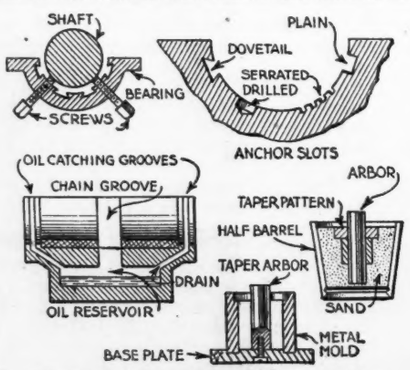
(*Continued from page 88*)

When possible, the bushing or bearing to be poured should be heated first so as not to chill the hot metal, as chilling has a tendency to crack the metal and causes abnormal shrinkage. Pour steadily and as fast as the gas formation will permit, and do not stop, as a stop will result in a lap or crack. When pouring large bearings that require several ladles, have them all hot and ready.

To make Babbitt metal hold in half circles and on flat surfaces, a system of grooves or slots is required as an anchorage. The surface of brass or bronze metal bushings sometimes is tinned with a half and half solder; this causes the poured Babbitt metal to unite perfectly. If a bearing is to be poured and no other provision has been made for anchorage, a drill is used to make shallow depressions, as shown. These shallow holes ordinarily should be only about ¼ in. deep and of the same or larger diameter, and should be spaced 1 in. apart. Grooves can also be chipped in the bearing pads with a cape chisel. Dovetailed grooves, slanting holes, or tapped holes must be used on flat surfaces.

Bearings are babbitted to size or, if smaller, bored to size. Rough work, where the accuracy of alinement and size is not important, is always babbitted to size. An old machine shop saying is that "the skin of the metal will be worth more if left unscraped than ½ in. of the metal beneath," the logic being that the surface skin is the densest and toughest, and therefore will wear and last much longer than the metal below.

In order to withdraw an arbor and prevent it from sticking, every one uses either oil, smoke, or paper in some form. Oil really should not be used, as it gases too much and causes bubbles in the surface of



Alining and supporting a shaft, making anchor slots, a typical babbitted box, and sand and metal molds

the poured metal. Heavy white lead, smeared on thinly and evenly, is perhaps the best for all around purposes. A single thickness of thin paper, either held with strings or with ends lapped and glued, will provide clearance for rough work.

Smoking the surface of the shaft with an oil torch will give a fine, dry surface, which does not gas at all, and the deposit of lampblack permits the easy removal of the shaft. Painting the shaft with clay, mixed to a thin solution with water, is another method sometimes used.

Where accuracy is necessary, the bearing must be bored and reamed to size. Large bearings that are to be bored to size are usually peened. The hammering makes the

(*Continued on page 91*)

"Red Devil" Rapid Boring Auger Bits are 33⅓% easier boring, have 10% greater clearance and bore with or against the grain of any wood. Style 2400—10/16 in. shown here, 75c.

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Reg. U. S. Pat. Off.
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YOU need a pair in the tool chest. You never know when you may have use for them.

For roof repairs, soldering jobs, for cutting tin, sheet zinc, sheet iron or copper, stove pipe, window screen wire, and for kindred work, you will find "Red Devils" mighty handy to have around.

"Red Devil" Snips will enable you to do many things for yourself that you would otherwise pay to have done.

Built of the best tool steel. Designed to cut with the least effort and stay sharp. Size 7 inches long.

"Red Devil" Snips No. 578—at all good hardware dealers, or if not in stock, send 90c. and dealer's name for a sample tool.

The "Red Devil" Mechanic's Tool Booklet is a handy reference guide for users of good tools—send for it—it's free.

SMITH & HEMENWAY CO., Inc.
Manufacturers of "Red Devil" Tools
264 Broadway New York, N. Y.

"Red Devil" Glass Cutters—the glaziers' standard tools of the world. "It's all in the wheel." Made in 40 styles. No. 024 shown here, 20c.

Tricks in Babbitting

(*Continued from page 90*)

surface metal denser and also closes up any laps or cracks. Peening is to be recommended wherever possible. On solid bearings that are to be bored, an arbor is sometimes run through the hole on a press.

Heavy cardboard and thin wood are used to close the open ends of a bearing, the pieces being cut to fit the shaft. These pieces must then be luted against the metal of the bearing. Clay of doughlike consistency forms the ideal luting material. Some use putty, but even when used in a thick or semihard condition, it will soften and run under the heat of the molten metal. Clay sets and hardens quickly and can be dried artificially with a blowtorch. Wooden dams are also used and must, indeed, be employed when the amount of metal is large and where the fall in level due to shrinkage is great.

On common chain or ring oiling bearings, the shaft can be supported on duck or hemp packing rings, the rings being cut to the proper width and placed in the oil drain grooves. When babbitting such a bearing, fill the oil reservoir and passages with fine sand, and top off all the exposed sand with a ¼-in. layer of clay. Many a Babbitt "mine" has been poured by sticking cotton waste in a cavity and expecting it to hold back the hot metal.

When luting up the dams and crevices of a bearing, prior to pouring, it is a good stunt to place twisted strands of cotton waste in all of the crevices, as when the hot babbitt hits the waste, reinforced as it is by clay, it will stop, and by not coming in actual contact with the wet clay, will not generate any steam or gases. When pouring any bearing metal, always have a ball or two of clay lying handy for use in case of a broken dam or leak. The ball allows one to close a leak without the danger of burns.

When pouring a half bearing, level up both arbor and shell, and build a dam on each side at least ½ in. higher than the flanged surface of the bearing. This will provide for the shrinkage and will leave no sunken edge.

Castings small in size can be made in wooden molds, preferably dry, soft white pine. Bushings, thrust rings, and the like also can be cast in the rough in either an iron mold or in sand. When casting Babbitt metal in sand, first wet the sand with kerosene and then add enough water to make it ball up in the hand.

Metal molds should always be bored with a generous draft, and arbors for solid work also should have a good taper. All arbors should be clamped in place to avoid floating.

Labor Saving Features to Appear Next Month

A SIMPLE fixture that takes the guess out of dressing grinding wheels to accurate radii will be described by Henry S. Laraby in the November Better Shop Methods Department.

Joe V. Romig will have one of his characteristic "Old Bill" stories on how a typical old-time machinist taught him to speed up his work. This will be followed in another issue by a remarkably helpful article on laying out work.

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Training, practice and experience will teach you the methods of using files. The following NICHOLSON Files, because of their sharper cutting accuracy, finer temper and edgeholding endurance, have earned places in the equipment of the best workmen everywhere:—

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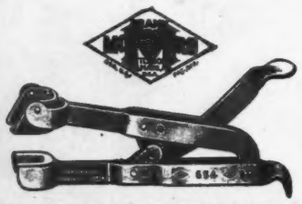
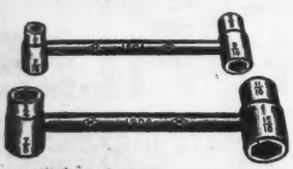
For every possible Ford job. Upstanding, two-fisted wrenches that are built to withstand the hardest work —day-in-and-day-out.

Examine the nearest stock of Mossberg Wrenches for Fords. You will find their construction superior to any you have seen. Their prices represent real value. Every Mossberg Wrench is made of Chrome Manganese Steel. Every wrench or tool is built to do a particular job—in the quickest, surest, easiest way.

Ask to see No. 654 Valve Lifter, Set No. 1944—"8 wrenches in 2" and other Mossberg leaders.



No. 654 Valve Spring Lifter for Fords



"Double Four" Socket Set —2 Wrenches, 8 Openings

FRANK MOSSBERG CO.

Lamb Street, Attleboro, Mass.

Building a Kitchen Cabinet Work Table

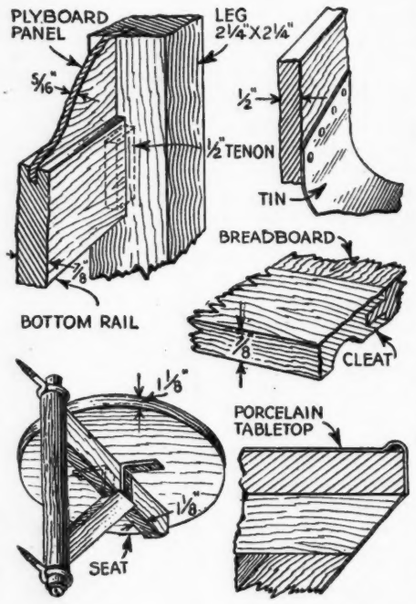
WHAT a workbench is to a shop, a kitchen table cabinet is to a kitchen. If properly designed and well made, it is a constant saver of the housewife's steps, time, and labor.

This kitchen work table—fully detailed in POPULAR SCIENCE MONTHLY'S Blueprint No. 27—can be built at a moderate cost for materials by any home worker who is handy with woodworking tools, and will give service equal to, if not more satisfactory than the average expensive table cabinet sold in department or furniture stores.

All the available space beneath the table top is utilized. There are three breadboards, four drawers—one partitioned for knives, forks, and spoons—a large bin drawer, a cupboard with two sliding trays, and a seat. The top may be either wood or a wooden frame with a commercial porcelain top, as preferred. The essential dimensions and main details are made clear in the accompanying illustrations.

Several modifications may be made, if desired. For instance, if so much drawer space is not required, the bin drawer and the drawer immediately above it may be omitted. This gives more knee room and makes the table somewhat more comfortable if much work is to be done sitting down. If it is preferred to use a stool or chair in place of the swinging seat, the seat can be left off.

While the seat can be constructed easily, care must be taken to make the pivot from stock not less than 1⅜ by 1¾ in. or 1½ in. in diameter, the arm 1⅛ by 1¾ in. and the brace 1⅛ by 1½ in. They must be of carefully selected hard wood to insure the necessary strength. Even then, if a heavy person is to use the seat, it should be fitted with a supplementary foot made of a ⅞- or 1-in. dowel, and attached at the outside end of the cross arm. This leg should be fitted with a caster so that it will slide over the floor easily when the seat is turned in and out. This takes much of the strain off the 2½-in. screweyes and the table leg.

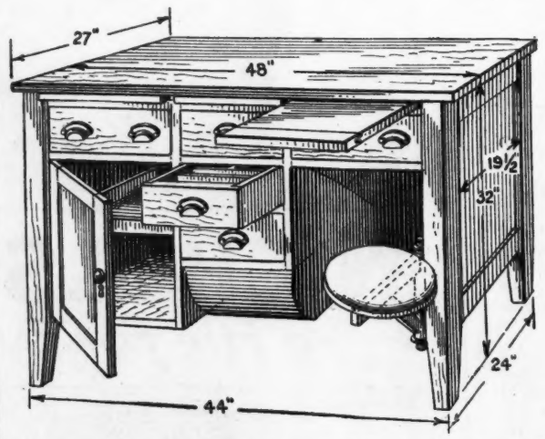


Ordinarily, the pivot would be simply a piece 1⅜ by 1¾ by 13 in., well rounded on one edge and with round pins turned at each end, but a heavy curtain rod may be used, if available, or, if a lathe is at hand, it may be turned throughout as shown, and the other pieces fitted neatly to it.

Standard woodworking construction is followed throughout. The rails are tenoned into the legs, but may be doweled, if the maker prefer. The legs are 2½ by 2½ by 31⅛ in.; the four top and bottom end rails, ⅞ by 4 by 20½ in.; and the end panels, 5/16 by 20½ by 18⅜ plywood.

If the cabinet is to be enameled white, which is usually the preferred finish, an excellent wood to use is whitewood, but any other soft wood that can be obtained easily and reasonably, such as white pine or cypress, will serve.

A complete bill of materials giving the exact sizes of the pieces needed in making the table, and full working details are contained in Home Workshop Blueprint No. 27, which will be sent to any reader for 25 cents.



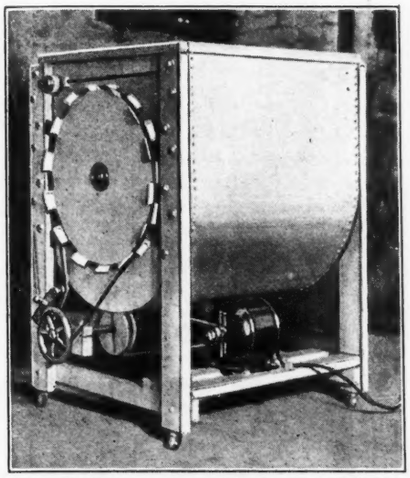
The general construction and some of the more important details of the kitchen cabinet work table. Full working details are contained in POPULAR SCIENCE MONTHLY'S Blueprint No. 27

Are You Taking Advantage of Our Workshop Blueprints?

MANY of our readers are spending pleasant and profitable hours of their spare time in making articles described in the Home Workshop Department and detailed in our series of blueprints. A letter from one of them, Charles L. Hausel, of Marcus Hook, Pa., is as follows:

> Inclosed find photograph of the electric washing machine I constructed from your Blueprint No. 12. The metal is copper, screwed to the cypress. The bearings are pieces of iron pipe filled with Babbitt metal.
>
> I made the 6-in. pulley on the countershaft of 1-in. wood, and the 3-in. pulley is one from a sewing machine, as I could not get any grooved pulleys. Every one is very well pleased with the results.

This is a typical letter, and articles by the thousand made from our Home Workshop Blueprints are being used everywhere.



For each photograph considered worthy of publication showing an article made from Home Workshop blueprints, like this washing machine built by Mr. Hausel, POPULAR SCIENCE MONTHLY will pay $2. Send prints to the Home Workshop Department, Popular Science Monthly, 225 West 39th St., New York.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to provide, upon request, information relative to tools, material, or equipment.

Blueprint Service Dept.
Popular Science Monthly
225 West 39th St., New York

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5.	Kitchen Cabinet	25c	☐
6.	V. T. Radio Receiving Set	25c	☐
8.	Shaving Cabinet	25c	☐
9.	Arbor with Gate and Seats	25c	☐
10.	Porch Swing	25c	☐
11.	Bench and Tilt-Top Table	25c	☐
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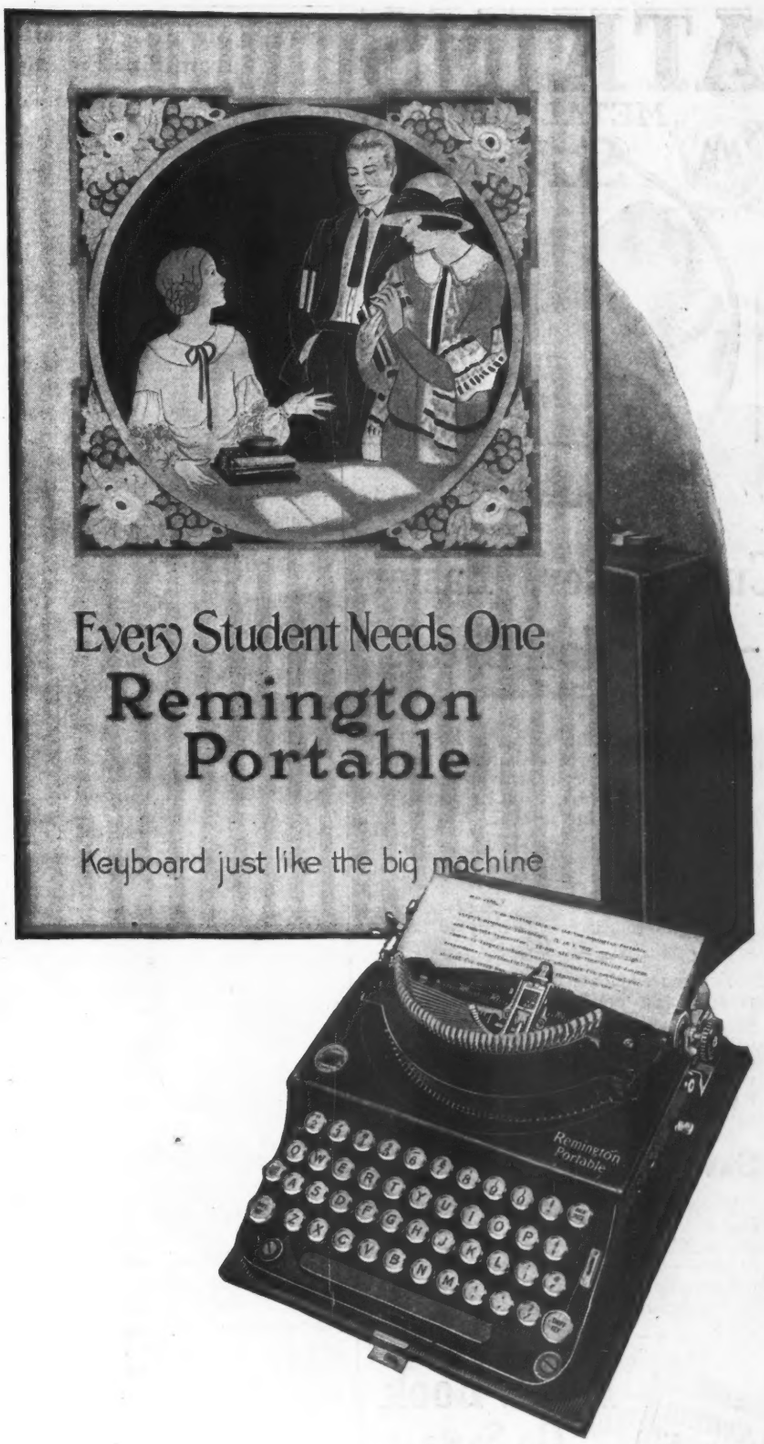

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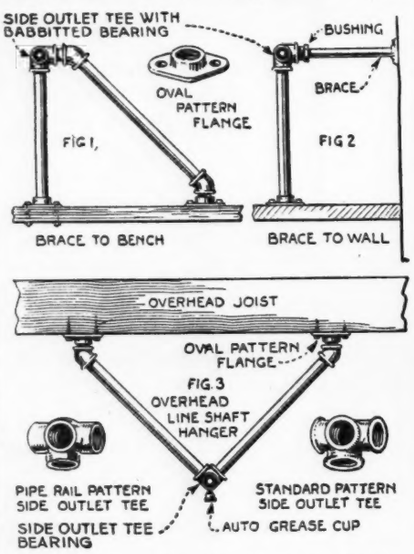
How to Make Rigid Shaft Hangers from Pipe Fittings

By John G. Hanna

MOST mechanics know that an excellent light shaft support or hanger can be made with a piece of pipe, a flange and a babbitted tee. In using such a support for carrying a countershaft some distance above my bench to operate a bench drill, I found that the belt could not be tightened very much and that there was a tendency toward vibration. The pipe, screwed tight, was rigid, but its length in combination with the small area of the base, gave it tremendous leverage on the more or less elastic wooden bench top.

The solution of this difficulty, I found, lies in the use of a side outlet tee in place of the ordinary tee. The additional outlet makes it possible to brace the hanger or support in one of the ways illustrated.

This fitting is not usually needed in the simpler kinds of plumbing and so is not always obtainable in small towns. In that case it is well worth the few cents postage required to order it from the nearest large city. The side outlet tee, commonly called "s.o. tee" for short, is, like most pipe fittings, made in two patterns, the standard for conveying fluids, and the pipe rail pattern for making up railings and fences. Either will serve well for a bearing, although the rail pattern makes a neater looking job.



Three types of serviceable shaft bearings made with side outlet pipe tees

For the countershaft support on my bench, I used the arrangement illustrated in Fig. 1, with 45-degree ells, close nipples, and suitable lengths of pipe, as well as the side outlet tees. It is not often possible to so cut and thread your pipe that the brace leg will meet the bench exactly when the main support is plumb. This is easily adjusted, however, by screwing the base to the nearest turn a little short of meeting and putting shims under the brace flange. With shears, the shims can be cut from tin, sheet iron, or 1/32-in. sheet lead.

If you measure your layout very carefully and don't cut the threads too loose, you can obtain a good line-up by screwing one flange on and the other off a trifle, even without shims. All braces are adjusted and screwed down permanently before the shaft is put in and the pipe bearings are poured.

The arrangement shown in Fig. 2 is

(*Continued on page 95*)

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How to Make Shaft Hangers

(*Continued from page 94*)

simpler if your bench is built against and fastened securely to a wall. A bushing in the side outlet allows the use of smaller pipe for the brace.

The same useful side outlet tees serve in another way to make the excellent overhead hanger shown in Fig. 3. As has been pointed out in this magazine before, overhead shafting should not be used in a basement shop, because it will vibrate the floor above, but in a regular shop, garage, or barn it has the advantage of not wasting any bench or wall space.

For the home workshop, lubrication can be supplied very easily by means of a small automobile grease cup screwed into a hole in the bottom of the bearing. Grease is not, of course, a satisfactory lubricant for a high speed shaft or for any shaft unless attended to at regular intervals.

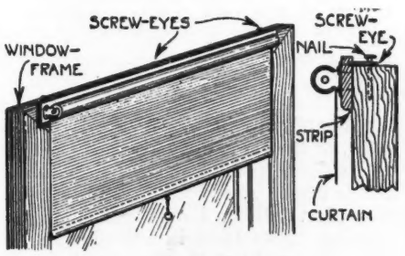
For mounting an overhead hanger on the usual 2-in. thick joist, oval pattern flanges are more satisfactory than the round type. This is another pipe fitting sometimes not to be had in a small store, but readily obtainable in large cities. It is well to ream the holes a trifle and use square head coach or lag screws instead of the slotted head screws for which the fitting is drilled and countersunk. For bench standards the common round flange is better, and through bolts and nuts are to be preferred to wood screws.

Attachment for Holding the Window-Shade Rollers

WINDOW shades may sometimes be used more satisfactorily if hung to the window-casings as shown below instead of in the usual fashion.

The shade and its brackets are mounted upon a light strip of wood or molding strip to match the style of window-casing.

Three screweyes are placed in the back of the roller support strip to hang it to



An auxiliary strip supports the roller brackets

the top of the window-frame over three small screws or nails placed in proper position.

This allows rollers to be used on window-frames that may not be exactly suited to the length of the roller, or do not permit the brackets to be placed in the requisite positions. The woodwork is not damaged or marred by the brackets and the shades are easily removed for cleaning or changing.

When installing the screweyes and nails, be sure to make all uniform so that the strips may be interchangeable for all of the windows.—B. F. DASHIELL.

Two varnishes of different kinds should never be mixed together because they will produce a new varnish that requires aging before use.

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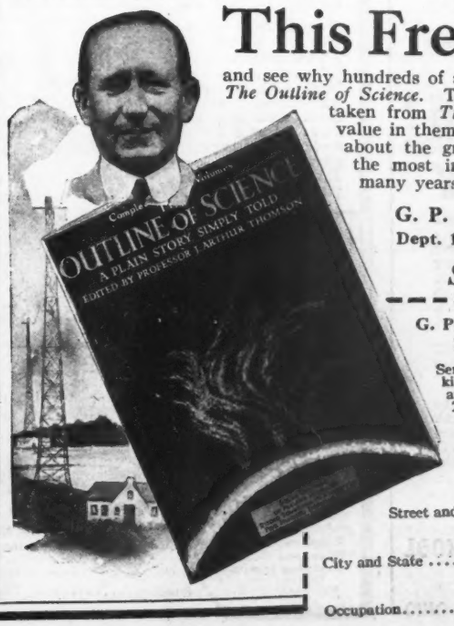

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Cheaply Made Garage Lighting Fixture Banishes Shadows

BY USING two inexpensive homemade reflectors, you can light your garage or shop with a mellow, diffused light that is much better for working purposes than the harsh light thrown by a single reflector.

The primary reflector is simply a 10-cent pan or basin. In the center of the bottom, inside, is fastened a porcelain socket with small machine screws and nuts. The inside of the bowl is then painted with two coats of white enamel or with aluminum paint. The aluminum reflects well but diffuses more than the enamel.

Three reflector arrangements

The secondary reflector may be made of wood and should be at least twice the diameter of the bowl. This is covered with tin or painted like the bowl. At a point equidistant from its center and slightly less than the radius of the bowl from the center, bore three holes. These should be only a trifle larger than the diameter of the wire to be used in hanging the bowl, and should pass squarely through at right angles to the face of the reflector. Solder three pieces of picture wire to the bowl, as shown, and run the wire through the holes in the secondary reflector, fastening them to strong screw-eyes. It will then be found that the secondary reflector may be moved up or down if the bowl is lifted a trifle to release the tension on the wire. It is, therefore, possible to adjust the secondary reflector at the point where it is most effective.

When the ceiling is too low to allow a secondary reflector, paint a circle with white enamel on the ceiling directly above the bowl. If the bowl is 15 in. in diameter, this circle should be about 4 ft. 6 in. An even better method is to mount an old mirror on the ceiling directly above the bowl, or suspend a mirror over the bowl, using four wires instead of three as in the case of the wooden secondary reflector.

The secondary reflector should be approximately 15 in. above the rim of the bowl, or the same distance above the bowl as the diameter of the bowl, in case a larger one is used. The best shape for a bowl is that of an ordinary hand basin.

When more light is needed than that given by a 75-watt nitrogen bulb, use two regular 60-watt lamps.—M. E.

Table Knife Quickly Converted into Photo Trimmer

A WASHINGTON, D. C., schoolboy who wished to trim a number of small photographic prints, improvised the paper trimmer illustrated. The blade is a cheap steel table knife, one edge being ground to a sharp bevel. The knife is attached to a block of wood with a round head screw and washer and a strip of sheet iron is fastened to the right-hand edge of the base. The surface can be laid off with guide lines for measuring—G. L.

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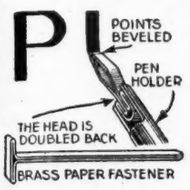
Brass Paper Fastener Serves as Heavy Lettering Pen

A DRAFTSMAN who does high-grade shaded lettering on certificates, testimonials, and showcards, rarely uses anything but pens made of brass paper fasteners for heavy lettering. The amateur draftsman will find this type of pen a useful makeshift when a commercial shading pen is not at hand.

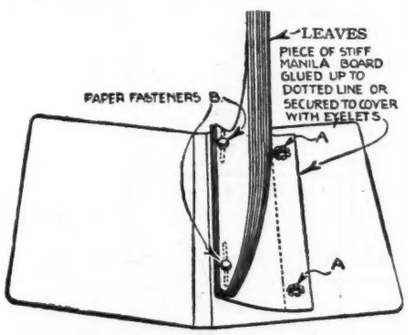


For "black letter" alphabets

A fastener should be chosen of a width corresponding to the width of the stems of the letters. The head is then doubled back to fit a penholder, from the center of which the split plug has been removed. The points are shortened, beveled back from the outside, and bent to form a reservoir for the ink. The edges are then filed to make them even.—C. M. T.

Speedy Method of Making a Loose-Leaf Notebook Cover

WHEN a loose-leaf notebook cover is needed quickly, or one of an odd size or shape is required, you can make it for a fraction of the cost of a commercial cover. The one illustrated, for a 4¼ by 7¼ in. sheet, is made of thin fiber board 7¾ by



An extra fiber strip inside the back cover holds the leaves

9½ in. Another fiber piece 2 by 6¾ in. is fastened with small metal eyelets, *A*, or paper fasteners to the cover, as shown. The loose leaves are then fastened to this strip with two or three paper fasteners, *B*.—A. E. STURDIVANT, Muncie, Ind.

When Grinding Wood Chisels

TO GRIND chisels and plane bits quickly and accurately I use a guide as shown. By holding the forefinger against the guide as a stop and running the tool to and fro sideways, never changing the grip when dipping the steel in water or examining the edge, I am sure to keep a true bevel.

A good many carpenters and cabinet makers, even after considerable experience, grind their tools "freehand" and therefore get several varieties of bevel before they obtain a good edge. An 8-in. length of ⅜-in. steel rod fixed about 1 in. above the arbor of the grinder makes a convenient guide. —WALTER LYON, Plymouth, Wis.

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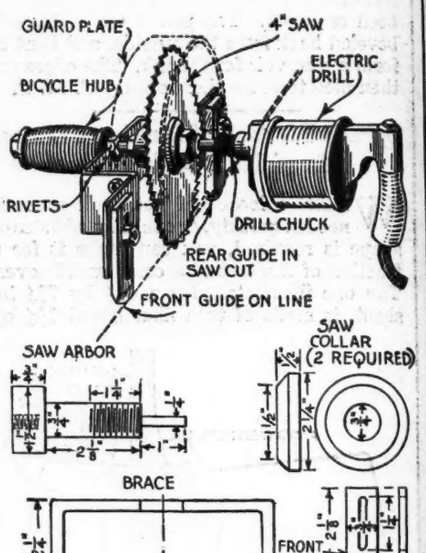
Making a Grooving Attachment for an Electric Drill

By Arthur M. Samp

IF YOU are a worshiper at the home workshop shrine, you will do well to add an electric hand drill to your set of tools. One can be made, should the expense of a commercial drill not be warranted. Then, having a drill, add the saw attachment for grooving that is illustrated below. It will greatly increase the pleasure of woodworking, especially furniture and cabinetmaking.

The saw arbor is turned from a piece of cold rolled steel about 1½ in. in diameter and 4 in. long. It is threaded with a left-hand thread and drilled and tapped to take the spindle of an ordinary bicycle hub. Two collars to hold the saw



Complete groover and details of the saw arbor, collars, brace, and guides

in place are purchased or made of mild steel.

A brace—of ¼ by 1 in. strap iron—for holding the guides is bent up and fastened to the face of the hub with small rivets. The front and rear guides are made of ¼ by ¾ in. strap iron and slotted with ¼-in. slots. They are fastened to the brace by means of 3/16 by ¾ in. stove bolts. The bicycle hub is wound with tape to form a suitable handle.

The guard is put on for safety, and it also serves to keep the sawdust from being thrown into the face of the operator. It is simply a piece of heavy sheet iron fastened to the brace.

The 4-in. cut-off saw can be purchased from any large hardware or woodworking machinery supply store, or even from one of the larger mail order houses.

To use the device for grooving, the small end of the arbor is placed in the drill chuck and the operator holds the drill in his right hand and the hub with his left. By means of the guides, the saw is made to follow the line. A scale of notches may be placed on the guides to make it possible to cut to a desired depth at the first attempt.

$25.00 in PRIZES See top of page 4 in front of book for full details.

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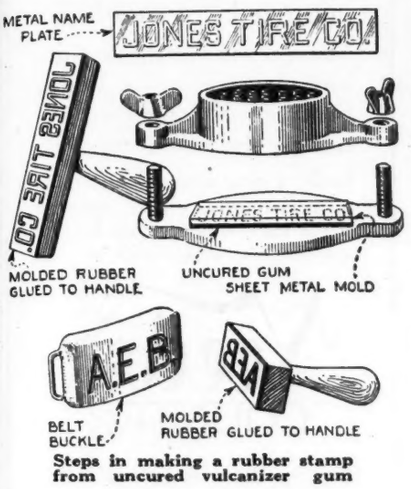
Rubber Stamps Can Be Made with Tube Vulcanizer

HOW easily a rubber stamp can be made with a small tube vulcanizer was demonstrated to me recently by a mechanic in a small tire shop. An aluminum strip with lettering such as is made by a stamping machine of the penny-in-the-slot type was used as a mold. It was coated with talc to prevent the rubber's sticking and covered with uncured vulcanizer gum. It was then clamped in the vulcanizer, which



Steps in making a rubber stamp from uncured vulcanizer gum

was lighted for the same time that it takes to attach a patch. The resulting rubber stamp requires merely to be glued to a handle. If a strip of sponge rubber is placed between the stamp and the wood to serve as a cushion, however, the impressions will be clearer.

Monograms or other engraved lettering or designs may be used as molds, or a mold can be prepared for a facsimile signature stamp simply by etching or engraving the characters in metal. Punching thin metal with suitable stamps is another way of providing molds. Whenever a simple stamp is needed in a hurry, this is an excellent way to make it.—A. G.

How to Fasten Fence Wire to Iron Posts

DISCARDED iron pipes often can be utilized for fence posts if they are cut to length and given a coat of asphaltum paint to prevent them from further rusting. This would be done more frequently if simple methods for fastening wire to such posts were known.

One system consists merely of making a series of angular saw slots with a broad-cutting hacksaw blade. The wire is placed in this slot, stretched tight, and held by peening the slot shut.

In the other method, three holes are drilled where each strand crosses a pipe standard. Two of the holes are opposite each other and the third is immediately above one of them. A number of short pieces of wire are then bent around a block to the hook shape shown and used to clamp the fence wire.—J. V.

Two simple methods

These groups of stockholders illustrate the rapid growth in ownership of the Bell System.

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They constitute a representative cross-section of American citizenship. Among them, of course, are bankers and men of large affairs; for the idea of ownership in the Bell System appeals to sound business judgment and a trained sense of values.

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No institution is more popularly owned than the Bell System, none has its shares distributed more widely. In the truest sense it is owned by those it serves.

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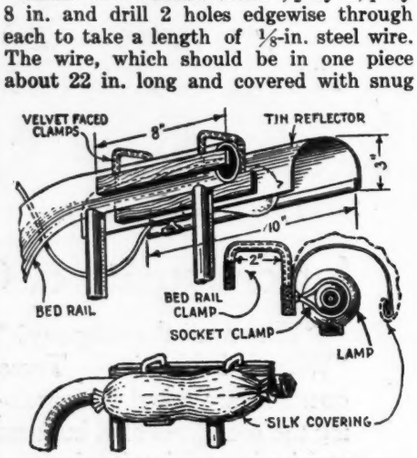
Make Better Mechanics

Can Serves as a Reflector for Ornamental Bed Lamp

NEAT and inexpensive to make, the reading lamp illustrated is designed to hook on to the head of a bedstead. Its reflector is nothing more than a can about 5 in. in diameter and 10 in. long, cut lengthwise so that it will form a semi-circular roll about 3 in. deep.

Make two wooden cleats ½ by 1¼ by 8 in. and drill 2 holes edgewise through each to take a length of ⅛-in. steel wire. The wire, which should be in one piece about 22 in. long and covered with snug



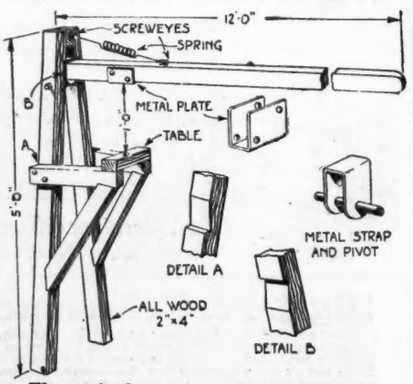
Scraps of tin, wire, wood, and silk form the parts of this serviceable night light

fitting rubber tubing, is bent into a U and slipped through the holes in the cleats. The ends of the wire are clinched to prevent the rear cleat from dropping off.

Next, bend the wire to form a clamp over the head of the bed, as shown. Cover the cleats with velvet to protect the finish of the bed. Fasten the reflector to the front cleat with screws and inside attach a wire loop 1¼ in. in diameter to hold the lamp socket. Solder ends to the reflector, and make a hole for the lamp-cord to pass through, being careful to roll the edge to prevent chafing the insulation. Cover the reflector with ruffled silk, fasten a socket in the wire loop, make the connection, and the light is ready for use.—EDWIN M. LOVE, Alhambra, Calif.

Light Press Built Cheaply from Two by Fours

BUILT mainly of 2 by 4 in. lumber, this cheap homemade press serves for putting in or removing bushings and gears, straightening parts, and performing similar



The 12-ft. lever gives power enough for all press operations usually encountered in the home workshop

work that requires considerable pressure.

By the use of suitable blocks, short pieces of pipe, and mandrels, almost any simple press work can be done with this press.—L. G.

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The Set-Back Rotary Ratchet Counter below is for machines such as presses and metal-stamping machines, where a *reciprocating* movement indicates an operation.

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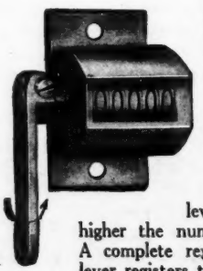
This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording the output of innumerable small machines When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The further the lever is moved, the higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted to no end of counting purposes, by regulating the throw of the lever. Price, $2.00. (*Cut nearly full size.*) Small *Revolution* Counter, also $2.00.



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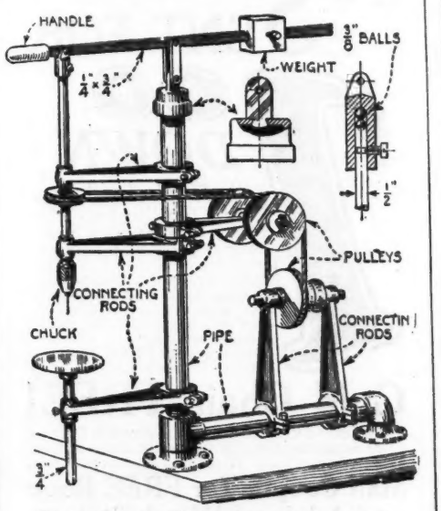
Connecting Rods and Pipe Form Sensitive Bench Drill

BY UTILIZING connecting rods such as are used on Ford cars, the home worker can make himself a handy sensitive bench drill at little cost for material.

The parts needed are six connecting rods, some 1-in. pipe, one T, one ell, one cap, two close nipples, and two pipe flanges. The pulleys in the drill illustrated were taken from old oilers, but they can be cast from babbitt and turned up on a lathe or made in any other way that is convenient. The ½-in. shafts run in bronze bushings clamped in the ends of the connecting rods. The connecting rod that carries the idler pulley shaft must be heated and bent one quarter around at the small end.

The drill table is a fan pulley flange with a ¾-in. shaft long enough to allow up and



The accuracy of this homemade bench drill is insured by the use of six light automobile connecting rods for the more important parts

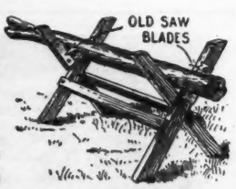
down adjustment. A bolt in the end of the supporting connecting rod clamps the table at any height.

The hand feed rod and other parts are made as shown, from material found in the junk pile. A lead weight with a setscrew goes on the end of the feed lever to keep the drill up.

Light, quick, and sensitive, this drill will do as accurate work as the amateur mechanic and car owner usually requires.—GEORGE H. CAPPEL, Wilmer, Ala.

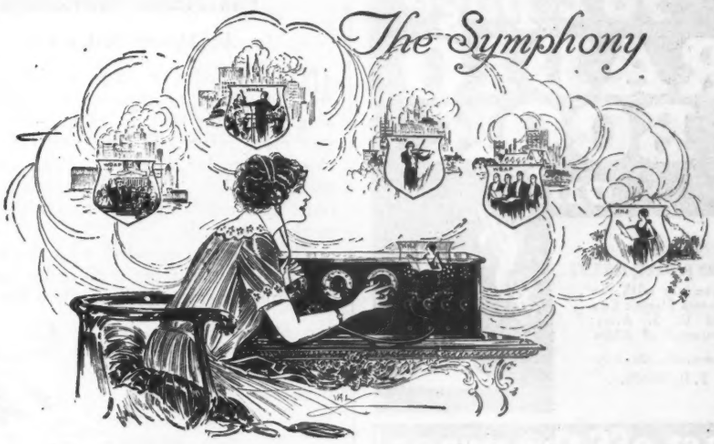
Saw Teeth Improve Wood Rack

TO KEEP round firewood from turning in a wood rack or sawbuck, it is necessary only to nail to diagonally opposite arms of the rack 8- or 10-in. sections of a broken or discarded crosscut saw. These are placed as shown, with the teeth projecting ¼ or ⅜ in. In fact, one section usually is sufficient.



The old saw blade can be cut and punched while hot, as it is not necessary to preserve the temper of the teeth.

If children are accustomed to play around the woodpile, always leave a good sized pole of wood in the rack. This will serve to guard the projecting teeth and prevent accidents.—E. H. TAYLOR, Howell, Tenn.



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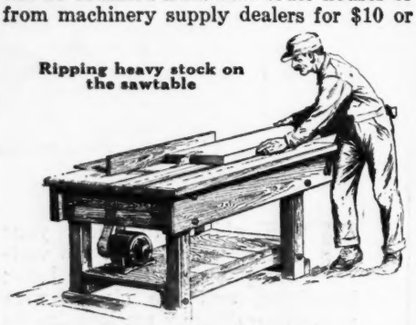
Constructing a Sawtable for the Home Workshop

By Henry S. Laraby

FOR the home or farm workshop where the necessary power is available, no single machine will do as much work and pay more returns in time and labor saved than a circular sawtable. The one illustrated has been so designed that it can be built at a minimum cost and with as little work as possible.

The complete mandrel with the bearings can be obtained from mail order houses or from machinery supply dealers for $10 or

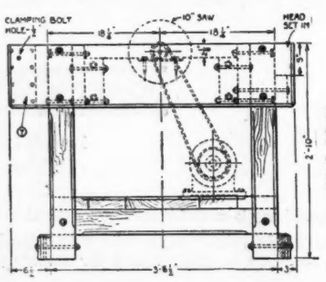


Ripping heavy stock on the sawtable

less. A standard size is a mandrel 1⅛ in. in diameter and 16½ in. long, with a 2½-in. flange, a 2½-in. pulley with 3½-in. face, weighing about 22 lbs. complete. This takes a saw with a 1-in. hole. It is ordinarily much cheaper to buy such a combination than to have a mandrel turned and the boxes made in a machine shop.

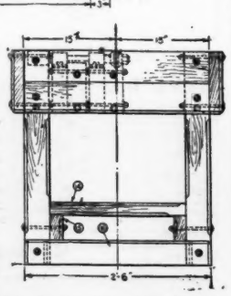
The help of a blacksmith may be required to bend the ⅜-in. thick tilting plates (No. 6), but even that can be done at home if sufficient heat is applied to the metal. While it is not important that the bend should be sharp, it is better to have the pieces true right angles. The wood may be left rough or planed at the mill, according to the degree of finish desired.

In putting together the top of the table, try each strip with a plane or otherwise to find the direction of the grain, and arrange



Front and end views of the saw-table frame

the strips so that the grain will run the same way, that is, from the working end toward the other end. This will aid in getting a perfectly smooth top and prevent it from roughening up when boards are pushed over it.



In constructing the top, the piece that corresponds in width to the ways running the length of the table should be ½ in. less in thickness than the other pieces, to allow for the thickness of the iron strips that form the ways. The grooves for the pair of crossways are made after the top is assembled.

The top is fastened with hinges to the frame, as shown, after the four tilting

(*Continued on page 103*)

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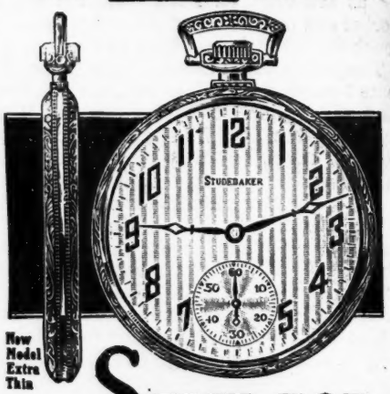

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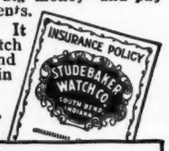

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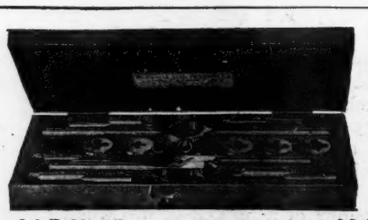

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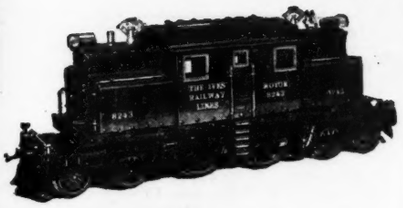

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Ives Toys
MAKE HAPPY BOYS

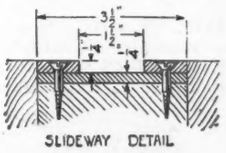
Constructing a Sawtable

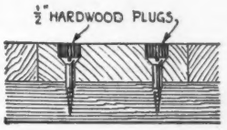
(*Continued from page 102*)

plates have been put in place. It should be noted that one right-hand plate and one left-hand plate No. 6, and one right- and left-hand plate No. 7 are required. By tilting the table, the depth of the saw cut is regulated.

The framework may be painted, shellacked, oiled, or varnished, except the table top, which is simply oiled. It is advisable to paint the inside of the top to exclude dampness as much as possible.

The detachable ripping fence permits making cuts at angles up to 45 degrees. Cross cut angles are obtained by adjusting the cross cut fence, and to facilitate angular work a scale of degrees may be laid out on the cross cut fence sector.



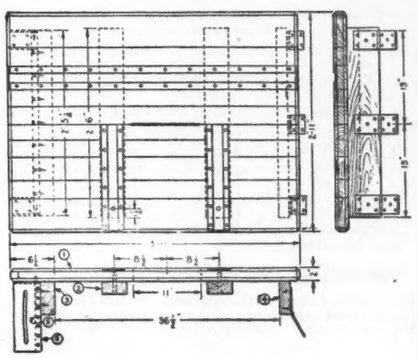


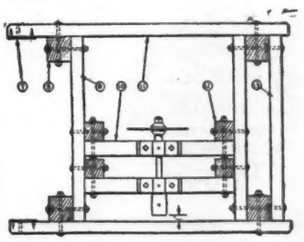
The list of materials for the sawtable is as follows:

Table top, 2 by 35 by 47 in., maple or birch.

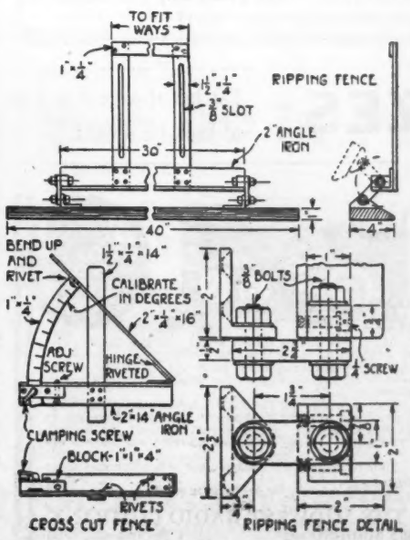
Top cleats, 2 by 4 by 30 in., oak, 2 required.

(*Turn to page 104*)





Details of the table top (above), general plan of the frame (at left), and fence details (below)

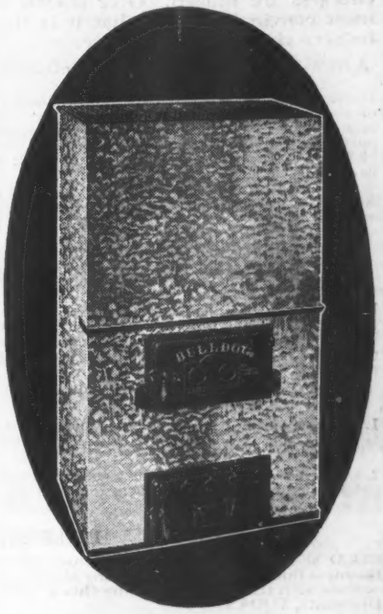


2½ Tons Heats 5 Rooms!

"There is no heater to compare with the Bulldog. I burned 2½ tons of coal last winter and heated five rooms and bath." —Walter Geary, Gloucester, Mass.

That's what the Bulldog does with coal! Here's what it does with about the lowest grade fuel you can think of!

"I can run my Bulldog furnace steady for fourteen days in normal weather conditions ***on the actual cost of fifty cents.***" So writes F. R. Redetzke, of Cleveland, North Dakota, and he adds: "Hard to believe, is it? That's what some of my neighbors thought until I showed them! We have an unlimited amount of grain screenings in this country. That's the fuel I am using."



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Puts the Bulldog in Your Home

and then Only $10 a Month!

It you are even thinking of a pipeless furnace, or any furnace, write for our free catalog. The Bulldog is one furnace you MUST investigate. Comes completely erected. You install it yourself! A really extraordinary development in heating. Factory connections in both East and West. We ship from nearest point. Don't consider buying any furnace until you find out about the Bulldog. Write now — before you forget!

Fits Any Floor Height

No matter what the depth of your basement or cellar may be — the Bulldog fits it. The adjustable casing (another common sense feature) takes care of this.

Write at once for our offer and our free catalog together with the wonderful record of Bulldog success. Mail this coupon Today.

Babson Bros.
19th and California Ave., Dept. 13-67, Chicago

Without obligating me in any way, please send me your free catalog and $10 down offer on the Bulldog Pipeless Furnace.

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Nothing speaks so eloquently of HOMCHARGER satisfaction as the fact that thru sheer merit alone it has become the *standard* by which all other battery chargers are judged. Over 125,000 HOMCHARGERS already in use offer the most convincing proof that it is the most efficient, economical and fool-proof battery charger at any price.

A NEW TRADE-MARK FOR A TRIED AND PROVEN PRODUCT

Its phenomenal success has led to the introduction of many inferior and make-shift imitations. To insure our reputation and protect the buying public against substitution, the Radio De Luxe HOMCHARGER henceforth will be sold under a new Trade-Mark, viz.:

GOLD SEAL HOMCHARGER

Retaining the same fundamentally correct operating principle and beautiful appearance of our Radio De Luxe model, it is a step nearer ultimate perfection through adoption of several construction refinements dictated by the policy of Progress.

HOMCHARGER'S 10 POINTS OF SUPERIORITY

1. **Simple**—Only one moving and wearing part, replaceable after thousands of hours use for $1.00. Will last a lifetime.
2. **Efficient**—Uses less than one-half the current of any bulb or liquid type rectifier. Will charge any radio or automobile battery for a nickel.
3. **Quick**—Its high charging rate of 7 amperes eliminates long waiting for battery to become charged. Will charge any "A" or "B" battery over night, or three times as fast as a 2-ampere machine.
4. **Clean**—No expensive bulbs to break or acids to spill or replace. No acid fumes. Charges without muss, fuss or bother.
5. **Dependable**—Tungsten contacts insure continuous operation—prevent sticking and stopping.
6. **Fool-Proof**—Can be operated by anyone. Attach to lamp socket and connect battery either way, it will always charge. High-grade ammeter eliminates guess work.
7. **Safe**—No danger of shock or fire. Tested and approved by Fire Insurance Underwriters everywhere. Gives tapering charge—will not overheat or injure battery.
8. **Beautiful**—Mahogany and Gold Finish.
9. **Unqualifiedly Guaranteed.**
10. **Popularly Priced**—Retails at $18.50 complete ($22.00 Canada). No extras to buy. Sold by all dealers.

FREE BROADCASTING LIST. Send today for Free List of Broadcasting Stations, and Circular Describing the Gold Seal Homcharger.

DEALERS! JOBBERS!

GOLD SEAL HOMCHARGERS will outsell any other radio device this season. "GOLD SEAL Business Builders" illustrates many attractive sales helps and explains how we are prepared to co-operate with the Trade in making this a "HOMCHARGER Year." Send for your copy and Trade Discounts, TODAY.

Insist on the GOLD SEAL — LOOK FOR IT

GENUINE GOLD SEAL HOMCHARGER REG. UNQUALIFIEDLY GUARANTEED

It is your protection against substitution. When buying *order by name* and *verify by the GOLD SEAL*, which appears on the carton as well as the nameplate

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Largest Manufacturers of Vibrating Rectifiers in the World

$25.00 in PRIZES

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treat bruises

and possible breaks of the skin with the *antiseptic* liniment. Removes pains and reduces swellings—kills germs and prevents infection. Only a few drops required. Safest for children. $1.25 at druggists or postpaid. Liberal trial bottle, postpaid, 10c.

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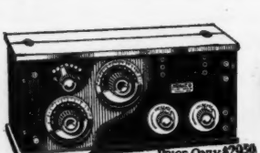
Absorbine Jr.
THE ANTISEPTIC LINIMENT



PRICE ONLY $29.50

MIRACO GETS 'EM 1500 MILES AWAY

At the low prices shown below you get the efficiency of sets costing three times as much.

These radio frequency receivers pick up stations over 1,500 miles away under good conditions—everywhere.

Operate either on DRY CELLS or storage battery.

Cabinets of solid mahogany and workmanship the finest throughout. Order direct or send for bulletin.

Two tube outfit, as shown above, headphones only $29.50

Four tube outfit for loudspeaker or headphones $54.50

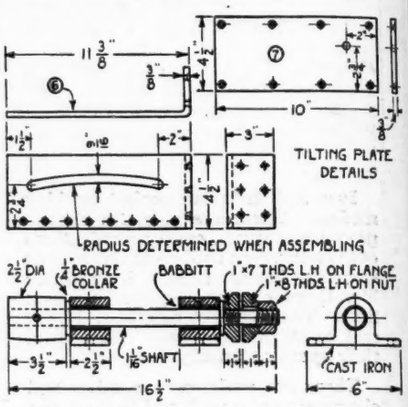
DEALERS AGENTS—*write for proposition quickly—it's a winner.*

THE MIDWEST RADIO COMPANY
808 Main Street Cincinnati, Ohio

Constructing a Sawtable

(*Continued from page 103*)

Top cleat, 2 by 5 by 29¼ in., oak.
Top cleat, 2 by 5 by 30 in., oak.
Plate brace, 1 by 11 by 28½ in., oak.
Tilting plates, ⅜ by 4½ by 14⅜ in., iron, 2 required.
Tilting plates, ⅜ by 4½ by 10 in., iron, 2 required.
Legs, 4 by 4 by 34 in., oak, 4 required.
Cross rails, 2 by 10 by 30 in., oak, 2 required.
Bearing beams, 3 by 7⅞ by 24 in., oak, 2 required.
Table aprons, 2 by 10 by 46 in., oak, 2 required.
Tie pieces, 3 by 3 by 7⅞ in., oak, 4 required.
Hinge cross rail, 2 by 5 by 30 in., oak.
Motor shelf, 2 by 22 by 36½ in., oak.
Leg tie pieces, 2 by 4 by 36½ in., oak, 2 required.
Lower cross rails, 2 by 4 by 30 in., oak, 2 required.



Details of the tilting plate and the arbor. The latter is standard and can be purchased cheaply

Heavy hinges, 3 by 4 in., steel, 3 required.
Strips for slideways, ¼ by 1 by 17 in., iron, 4 required.
Strips for slideways, ¼ by 3½ by 17 in., iron, 2 required.
Strips for slideways, ¼ by 3½ by 47 in., iron, 2 required.
Strip for slideways, ¼ by 3½ by 47 in., iron.
Bolts, ½ by 6½ in., 16 required; ½ by 5½ in., 6 required; ½ by 6 in., 18 required; ½ by 8 in., 2 required; ½ by 2¾ in., 2 required; ½ by 4 in., 2 required.
Lagscrews, ½ by 4 in., 2 required.
Screws, No. 14, 1¼ in., 1 gross; No. 14, 2¾ in., 1½ gross.
Hardwood plugs, ½ in., 200 required.

Fence Materials

Angle iron, 2 by 2 by 14 in.
Angle iron, 2 by 2 by 30 in.
Strip, ¼ by 1 by 19 in., iron.
Strip, ¼ by 1½ by 14 in., iron.
Strip, ¼ by 1 by 14 in., iron.
Strip, ¼ by 2 by 16 in., iron.
Strip, ¼ by 1½ by 15 in., iron, 2 required.

A motor of 2 hp. is required for average work. If heavy cutting of hard woods is to be done, it would be better to use 3 hp. The switch should be placed in a position where it can be reached handily. It is well to have a locked or padlocked switchbox to prevent the saw's being operated by any one not skilled in its use, as the machine, like most woodworking machines, is dangerous unless properly handled. The utmost caution should be used at all times in operating it, as with a standard sawtable.

A countershaft can be used in place of the motor if the saw is to be driven by a belt from a gas engine, an auto wheel, a tractor, or other source of power. The pulleys should give a speed of at least 900 r.p.m., although theoretically the rim speed of a circular saw should be about 9000 ft. a minute, which means in the neighborhood of 2800 r.p.m. for a 10-in. saw. In other words, the high speeds are better if the power is sufficient.

Electric Iron Alarm

RECENTLY we found the house full of smoke caused by a red-hot electric iron that had been left on the ironing board. To prevent a similar accident, I placed a two-way socket at the end of the drop and screwed the iron plug in one and a red light in the other. The light reminds one to switch off the current.—G. M. V. H.

Still Time to Enter "The Most Useful of My Tools" Contest

IF YOU are reading this issue of POPULAR SCIENCE MONTHLY before September 20—it goes on the newsstands September 10—you still have time to enter the current tool contest and perhaps win one of the three prizes.

All mechanics and home workers do not agree on which is the most useful of their tools. Some prize most highly the saw, others the hammer, others the ax, the plane, the chisel, the file, the screwdriver, and so on. Mr. Romig put up an excellent argument last month for the steel tape line.

Now then—which is the most useful of *your* tools? Which one do you use most? Why? And how? Undoubtedly you have some uses for your tools that nobody else has thought of. Tell us about it in a letter of not more than 400 words.

We offer these prizes: $25, first prize; $15, second prize; $5, third prize. The competition closes September 20. The winning letters will appear in the January issue.

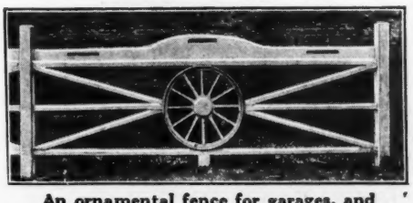
Each letter will be judged by the Board of Editors and their decision will be final. No letters will be returned unless accompanied by a self-addressed, stamped envelope.

Address, Tool Contest Editor, POPULAR SCIENCE MONTHLY, 225 West 39th St., New York.

Auto Wheels Form Decorations for Fence Panels

AN UNUSUAL design for a fence can be obtained by using discarded auto wheels as decorations. Such a fence is especially appropriate around a filling station or on the grounds about a garage.

The construction is simple yet rigid. The top and bottom rails of each panel are



An ornamental fence for garages, and for general fencing purposes

2 by 2 in. and the wheel is held between them by the flanges of the iron rim. The fillers and braces are also 2 by 2 in. but the posts are 4 by 4 in. Good proportions are obtained by setting the posts 9 ft. apart. A 1-in. board cut in some simple pattern finishes off each panel neatly.

Paint the wheel some darker color, such as green and the rest of the fence white.—C. L. MELLER, South Fargo, N. D.

WHY NOT YOU?

Garage foreman at $75.00 a week
—and in line for further promotion

Positions like this are waiting for men who can fill them. AND BIGGER JOBS AHEAD. Above the foreman, there is a better job as Service Manager. Every automobile dealer, every service station in every city in the country, needs one or more high grade foremen or superintendents. "Where can we get trained men?" they ask despairingly. *They will willingly pay big money to you if you can fill one of these jobs.* They want men who are not only good auto mechanics, but who know *shop management, modern repair methods, electric service,* and who have a thorough understanding of the business as a whole.

You can get that knowledge in three months at the Michigan State Automobile School in Detroit, the Auto Center. Men in low paid, uninteresting trades, can fit themselves for better jobs now, or a business of their own. Miners, railroad men, street car men, furniture men, barbers, laborers of all kinds, are lifting themselves out of the rut, and establishing themselves, by taking M. S. A. S. training.

I Can Make You a Big Money Man
Whether You Are Now a Mechanic or Not

Are you mechanically inclined? If so you can develop that aptitude and make a success in the automobile business. Not necessarily as a mechanic, but as a business man—with a *foundation* of mechanical training so that you "know how" and can direct the work of others. Our training will enable you to *rise above the ranks to a position of responsibility.* Successful men are not "born" they are "made." Foresight, planning, training, is what "makes" them.

Do you know that in *one month* of this year 404,000 new automobiles were built? Notice in every city, the automobile dealers have fine establishments. "Automobile Row" is the center of activity. The automobile dealer is the biggest man in this great business. Can you begin to imagine how great the need is for *big men* to lead the business of giving service to these cars? The opportunity is simply astounding. The industry has advanced so fast that enough trained men have not been developed to hold the big pay jobs.

I can fit you for one of these jobs, and even to run a business of your own, to have a service station or be an automobile dealer. Our graduates are doing it now all over the U. S. A., and in many other countries. *I can start you to success, as I have thousands of other men.* This School and its courses are endorsed by automobile manufacturers and service men.

Write to me today for full information. I want you to have a good job. I can qualify you quickly. Write to me today.

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I am earning $..... My age is.....

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This Wonderful Invention

converts any cook stove into a gas stove. Oxo-Gas made from kerosene and air is cheaper, cleaner and more efficient than coal. Send for catalog illustrating Oxo-Gas appliances for all purposes where coal is used. We have openings for General Sales Managers and distributors. Only those who can finance themselves considered.

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OIL EXPERTS in Demand
Good Positions Await Trained Men

The Petroleum Engineering field needs men. It needs them badly. With 10 million autos and thousands of new power plants a great shortage of lubrication engineers now exists—greater than ever before. Petroleum experts and lubrication engineers command big pay—$250 to $800 monthly. Thousands of National men are doing it—so can you. Learn at home in your spare time with the oldest and only school giving same instructions by correspondence as is given through resident school. (Certificate of Lubrication Engineering given).

BIG BOOK of Opportunities FREE

Send NOW for New Book, just out, "Opportunities in Petroleum Engineering." It is intensely interesting and instructive. It will show you many things you never knew about oil and lubrication problems. Also full particulars and special low fee awaiting those who ACT NOW!

National Engineering Schools
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Science Says Use Nu-Gas To Cook and Heat

Up-to-date homes being built without coal bins because there's a better, cleaner, easier way to cook, bake and heat, by burning free air.

"Don't buy coal at present price," says a Domestic Science Expert. Don't buy it at *any* price. You can get far better results by burning free air and oil in the way science has recently discovered. The government does it; the big ships do it; factories do it; and new homes are being built without coal bins or wood-sheds because their owners have adopted the new, clean, dustless, dirtless, laborless device which fits in any stove.

Oil and Free Air Make Wonder Heat

Science has shown that one part of coal oil (kerosene) the cheapest of fuels, can be mixed with twenty parts of air (by a remarkable burner) and the result is a wonderful heating and cooking gas. Cheaper than city gas. No fires to build. Heats at twist of the wrist. Heats largest rooms in a few moments on coldest morning. Heats oven evenly for baking. No dirt, smell or soot. Saves work, saves furniture, saves health. And a new way has been found to cut useless parts, so that, of all burners, the NU-HEAT (the latest one) is the best and lower in price. Installed in a jiffy in your present range, heater, furnace—then you are no longer a slave to coal and wood and the expense, labor and dirt they bring. Absolutely safe. Sent on 30 days free trial. Amazing ironclad guarantee.

Free Book About Remarkable Way to Burn Air

Learn how to cut housework in half. Learn to save by having all the heat you want but only when you need it. Learn cheap way to have the warmest, cleanest, cosiest home in town. Just say "send Nu-Heat information Free." Mention if you have heater, range or furnace. No obligation to you whatever.

AGENTS Make $50 to $200 a week. Full or spare time. Personal co-operation. Write quick for exclusive territory and free sample case offer.

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NEW TIRE

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ACT NOW

30X3½ CORD 2.00

WRITTEN GOLD BOND GUARANTEE WITH EACH TIRE

Greatest tire sale in America now on! Goodyear, Goodrich, Firestone, Fisk and other fine makes of tires going at record-breaking prices. These almost new tires will easily give thousands of miles of satisfactory service.

GUARANTEED 9 MONTHS

	TIRES	NEW TUBES		TIRES	NEW TUBES
30x3	$1.90	$ .90	32x4½	$3.75	$1.65
30x3½	2.00	.90	33x4½	3.75	1.65
32x3½	2.50	.90	34x4½	4.00	1.65
31x4	2.75	.90	35x4½	4.25	1.65
32x4	3.00	1.40	36x4½	4.25	1.65
33x4	3.25	1.40	35x5	4.25	1.95
34x4	3.50	1.40	37x5	4.25	1.95

Just send $1.00 deposit for each tire ordered. Balance C. O. D. subject to inspection. Our written gold bond guarantee with each tire positively assures you nine months satisfactory service or another tire will be given at half price. Shipment made same day order is received. Order today—NOW.

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Are You Reaching for the Truth?

I will tell you FREE Under which Zodiac Sign were you born? What are your opportunities in life, your future prospects, happiness in marriage, friends, enemies, success in all undertakings, and many other vital questions as indicated by ASTROLOGY, the most ancient and interesting science of history?

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Simply send me the exact date of your birth in your own handwriting. To cover cost of this notice and postage, **enclose ten cents** in any form and your exact name and address. Your astrological interpretation will be written in plain language and sent to you securely sealed and postpaid. A great surprise awaits you!

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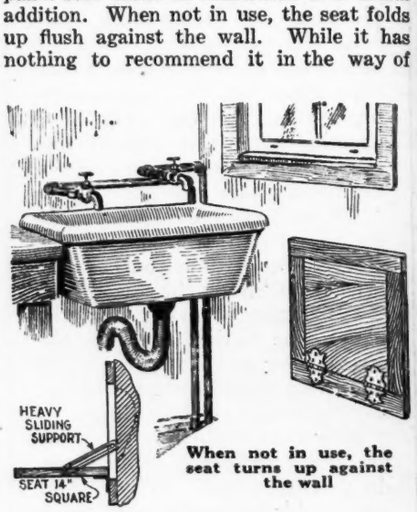
309 Fifth Ave., Dept. 137, New York

Panel Seat Saves Steps in Small Kitchenette

IN SMALL kitchens or kitchenettes, where every foot of space is valuable, a panel seat made as illustrated is a useful addition. When not in use, the seat folds up flush against the wall. While it has nothing to recommend it in the way of comfort, it does provide a handy rest for the housewife.

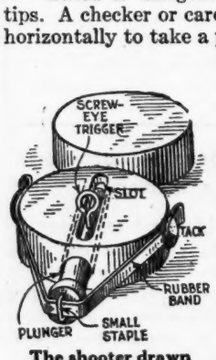


When not in use, the seat turns up against the wall

Chestnut or other hard wood 1 in. thick is used. The seat is fastened to the frame with two stout brass refrigerator hinges, and two very heavy sliding supports or stays hold the seat when down. A catch also can be added, although the seat illustrated remains up by tension and is opened by means of a small thumb notch in the upper member of the frame, not shown in the illustration.—A. G.

Carom Shooter Easily Made

THE simply made carom shooter illustrated is designed to save the fingertips. A checker or carom is drilled through horizontally to take a plunger made from a length of dowel or other small rod. A rubber band is tacked, as shown, and held against the enlarged end of the plunger by a staple.



The shooter drawn back for a shot

In operation, the shooter is held in place with the thumb and second finger, and the index finger is used to pull back the screw-eye trigger.—G.E.H.

Weaving Small Rubber Mats

USEFUL rubber mats can be made quite easily from 1-in. wide strips cut from old inner tubes. If some of the strips are red and others gray, interesting patterns may be arranged.

First tack down the lengthwise strips, stretching them slightly, and then weave the cross pieces. To fasten the ends, turn them in and weave back for about 6 in., pulling the ends snug and trimming neatly. Cementing the ends adds to the durability. —M. N. K.

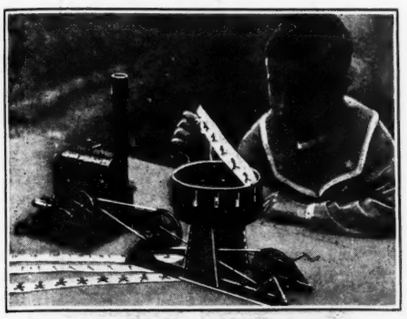
Many patterns are possible

Simple Motion-Picture Machine Amuses the Children

TO MAKE a simple and amusing motion-picture machine is not difficult and costs little. Paper, cardboard, wooden or metal strips, and two or more flanged wheels are the only materials required, unless a toy engine or motor is provided to drive the device.

The strips are put together, as shown, to form the base of the machine. In the center of the frame an upright shaft is placed, provided with a flanged drive wheel.

The upper part of the shaft carries the instrument proper, which is a cardboard

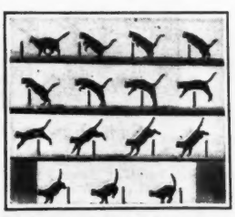


Inserting a "movie" strip in a toy "projector" operated by a small steam engine

disk about 6 in. in diameter, edged with a short paper cylinder containing a number of ¼-in. slits 1 in. apart. The disk can be any size, but the slits should be spaced and made as indicated. Their number varies according to the disk, but not less than 12 should be employed, and 15 or 16 give good results.

One end of the frame is provided with another shaft and wheel, the latter being connected with the horizontal wheel by means of a string belt.

By placing a strip of consecutive pictures inside the cylinder and looking at them through the slits while the machine is being turned, it appears as if motion is given to the series of pictures. These pictures are drawn on strips of paper and may represent anything desired, as jumping balls, the turning vanes of a windmill, a frolicsome cat or dog, the movement of a pendulum clock, and the like. Each picture must be drawn so that it is in a slightly advanced state from the preceding one and their number must be equal to the number of slits made in the machine.



A typical strip drawn for a fifteen-slot machine

Instead of setting this device in motion by means of a crank, a toy steam engine or electric motor can be attached, provided one or more sets of flanged wheels are added so that the motion is slowed down to the proper speed.—E. B.

"Loading" a Regenerative Set

IF IT is desired to "load" a standard regenerative radio set in order to receive stations sending on a wave length higher than 700 or 800 meters, loading coils must be connected in series in all three circuits—primary, secondary, and plate. These additional inductances can be honeycomb coils, pancake coils, or wire-wound tubes.—J. C.

ONLY $3 DOWN and you keep this typewriter

DIRECT to you from our Factory — Big Saving in Price

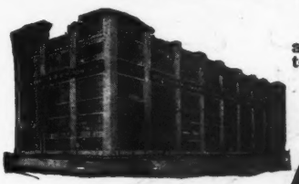
Yes, we will ship you this

Genuine Underwood

Rebuilt in our own factory just like new for

ONLY $3 down—NOT ONE CENT MORE

Until you have tried the machine 10 full days at our expense



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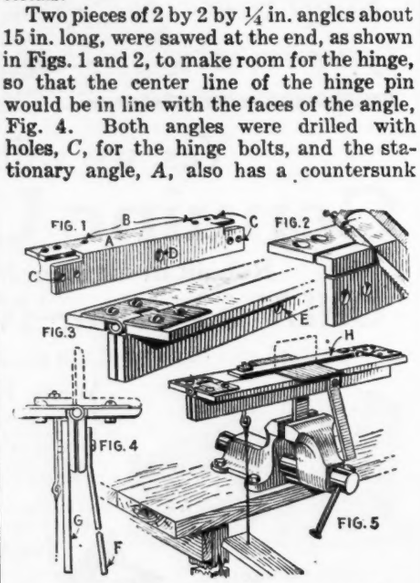
Homemade "Brake" Saves Time in Sheet Metal Work

By H. W. Hahn

TO OBTAIN uniform results in bending a large number of small sheet iron pieces at an angle, and in making rectangular sheet metal tubes, I constructed a small, serviceable brake from scrap materials.

Two pieces of 2 by 2 by ¼ in. angles about 15 in. long, were sawed at the end, as shown in Figs. 1 and 2, to make room for the hinge, so that the center line of the hinge pin would be in line with the faces of the angle, Fig. 4. Both angles were drilled with holes, *C*, for the hinge bolts, and the stationary angle, *A*, also has a countersunk



How the brake is made and set up in a vise for bending sheet metal

hole, *D*, to which the heavy strap, *G*, is bolted.

The movable angle is provided with a handle, *F*, bolted to the countersunk hole *E*. A piece of strap iron, *H*, 1⅜ in. wide was drilled near the end and these holes were lined up with the holes *B* in the angle *A*, ½ in. from the front edge. The strap *H* is bolted to the angle at one end, but the bolt is not drawn up tight. A long hook bolt through the other hole keeps the strap in position and allows the attachment of a simple pedal.

The device is assembled as shown in Figs. 3, 4, and 5. The piece of sheet metal to be bent is placed under the strap *H*. The pedal is pressed down and the handle attached to the movable angle is raised.

The brake may be improved by providing stops or marks for turning out duplicate pieces and a spring arrangement to lift the strap when the pedal is released.

Mounting Dry-Cell Radio Tubes

DRY-CELL radio tubes are sensitive to jars and vibration. Touching the panel or moving the controls often causes a disagreeable noise in the telephone. This makes it desirable to mount these delicate tubes in such a way as to protect them from being jarred.

To accomplish this, I use a rubber bath sponge with a flat base and top such as can be obtained in any five and ten cent store. Cut a piece slightly larger than the base of the socket, shellac it, and press to the baseboard of the set where the tube is to go. On it place a small square of composition or dry wood that has just been shellacked. Press this firmly in place and then shellac the top of it and set the socket upon it. When the shellac is thoroughly hard, this mount will be found firm and yet flexible enough to absorb ordinary vibrations.—M. E.

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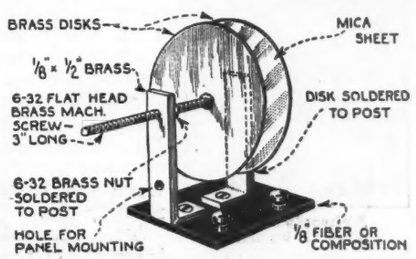
Micrometer Variable Condenser Made for a Few Cents

FOR a few cents a radio fan can make a micrometer variable condenser that will give exceptionally sharp tuning in connection with a large condenser or used alone where critical adjustment of capacity is required in a hook-up.

The condenser plates are two brass or zinc disks. One is soldered to a brass support, as shown, and the other is soldered to the head of a 6/32 brass machine screw 3 in. long. A 6/32 nut is soldered opposite a hole in another brass support and the machine screw turned into it. The two supports are then screwed to a ⅛-in. fiber or composition base. A thin piece of mica is shellacked to the stationary disk to prevent the plates from causing a short circuit.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6-32 BRASS NUT SOLDERED TO POST
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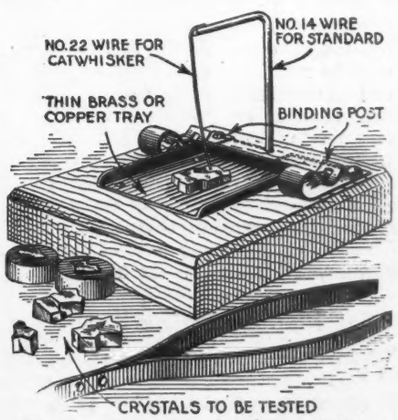
A two-plate condenser for fine adjustments

Drill holes for the binding posts and solder a wire from each to one of the supports. A dial and knob are fastened to the machine screw, a brass shim being soldered to the screw, if necessary, to make them fit. Turning the knob moves the plates nearer or farther apart by very fine degrees.—EDWIN G. GETTINS, Los Angeles, Calif.

Testing Radio Crystals Quickly

TO SAVE time in testing the relative merits of a number of mounted and unmounted radio crystals, I use the simple detector stand illustrated in place of the regular glass-covered detector on my set. Each crystal to be tested is placed on the copper tray with the tweezers, pushed under the catwhisker, and manipulated until the surfaces have been thoroughly tried out. Either the signals of a broadcasting station or a buzzer can be used for the test.



The crystals are turned under catwhisker

The base is a block of wood ½ by 2½ by 2½ in. A piece of thin copper or brass is bent up on three sides to form a tiny, shallow tray, fastened to the wood with escutcheon pins, and connected with one binding post. The catwhisker, with its end clipped to a sharp point, is mounted as shown and connected with the other post.—S. L. P.

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Fountain Pen Ink Bottle Turned into Spirit Lamp

WHEN you have drained one of those handy filler-top desk bottles of fountain pen ink, the empty bottle can be converted into a spirit lamp for the workshop or laboratory.

Nick the glass filler with a file just where it starts to contract in size, and snap it off clean. Then cut off the rubber bulb, draw the glass tube out of the stopper and insert it from the other end with its flared end down. A piece of cotton wicking and a little denatured or wood alcohol make the lamp ready to use.

A cheaply made alcohol burner

The flared lower end of the glass tube permits the wick to be drawn up as it is needed, by means of a pin. The sharp upper edge holds it from slipping back. The original metal screw cap acts as an extinguisher and keeps the alcohol from evaporating through the wick when not in use.—F. M. W., Jr.

Locked Barrel Is Useful for Storing Heavy Tools

ALTHOUGH heavy and large tools are almost invariably stored in the corner of the shop or barn because of the lack of a suitable box, this practice often results in loss or breakage.

A substantial and serviceable container for such tools is a tight coopered barrel, fitted with a reenforced cover, hinges, and a hasp. Such a storage place takes up little room and costs next to nothing, and the tools will always be found when wanted.

For large tools and bulky supplies

A locked barrel is a container of such large capacity that it is also useful for safeguarding other materials, such as harness, fuel, and oils.—L. A.

Making Shrink Fits

WHEN shrinking small parts together, it is not easy to obtain the precise fit necessary so that the outer part, when heated, will just slip over the inner. It is a matter of cut and try, plus care and experience. There is one little kink, however, that often has been found useful. If the fit has been made a trifle too close, so that the parts will not go together when the outer part is heated, it often will help matters to shrink the inner part slightly by putting it on ice until it is thoroughly chilled. When the two are assembled, there will be shrinkage from the outside and expansion from the inside. The work must be done quickly and there's some danger, if the outer part is not fairly substantial, that it will rupture from the pressure.—H. G.

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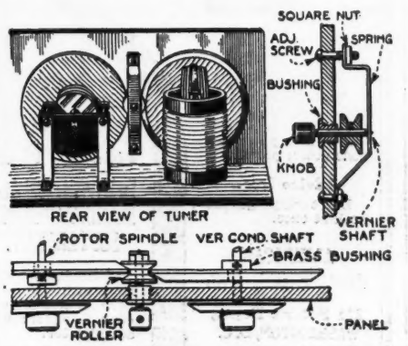
One Knob Provides Vernier for Two Radio Instruments

THE unusual feature of this Vernier control for a radio receiving set is that a single knob operates both the rotor of a variocoupler or variometer and a variable condenser. The operator makes fine adjustments of either without removing his hand from the knob, and this, of course, makes close tuning easier than if individual Verniers were used for the instruments.

Two disks of fiber or maple are turned, each with one beveled edge, and fixed to



Details of dual Vernier control. Note that the variocoupler and condenser are base mounted to allow room for the large disks

the shafts, as shown, by setscrews in their brass bushings. One beveled edge faces the front and the other the rear.

The roll is turned from fiber with two beveled surfaces facing each other. It is fixed to a floating shaft free to work in a brass bushing anchored in the panel. The pointed end of this shaft engages a hole in a bent-up flat spring, which is attached to the rear of the panel as shown.

The tension forces the beveled surface of the roll against the disk that has its beveled edge facing the rear and when the Vernier knob is turned, that disk moves. To turn the other disk, the knob is pushed in, thus forcing the roll in contact with the beveled edge of the second disk and out of contact with the first. This allows microscopic adjustments of both instruments to be made until precisely the correct tuning has been obtained.—C. M. WILCOX.

Waterproofing Shoes

SHOES can be made thoroughly waterproof at home by using any of the formulas given below. These have been

The sole is placed in grease that is warm but not hot for fifteen minutes

tested by the U. S. Department of Agriculture.

Formula 1: Neutral wool grease, 8 oz.; dark petrolatum, 4 oz.; paraffin wax, 4 oz. Formula 2: Petrolatum, 1 lb.; beeswax, 2 oz. Formula 3: Petrolatum, 8 oz.; paraffin wax, 4 oz.; wool grease, 4 oz.; crude turpentine (gum thus), 2 oz. Formula 4: Tallow, 12 oz.; cod oil, 4 oz.

In each case the ingredients should be warmed and stirred until they have been thoroughly melted and mixed together.—E. A. HIGGINS, New York.

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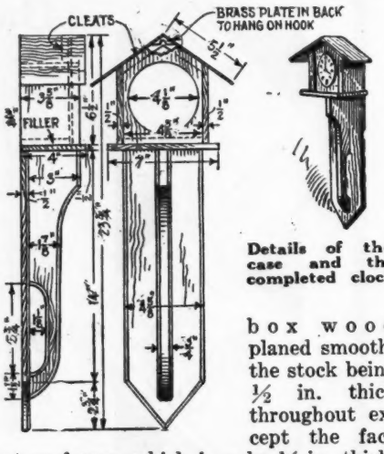
Handy Wall Case Improves Cheap Alarm Clock

BY THE addition of the case illustrated, a common alarm clock can be used as a wall clock during the day and as an ordinary alarm clock at night. The case, if neatly made and carefully finished, converts even the cheapest alarm clock into a clock of attractive appearance.

I made the first of these cases for the shop, where an alarm clock kept on a shelf had been knocked down again and again. I have since made several others.

The cases were mostly built of packing-



Details of the case and the completed clock

box wood planed smooth, the stock being ½ in. thick throughout except the face mat or frame, which is only ⅛ in. thick. The grain of this piece should run up and down and the circle be cut to suit the clock.

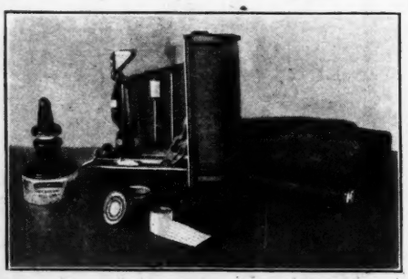
The gable in the case shown is at an angle of 30 degrees. A filler piece is required to raise the clock a trifle off the floor. I have a ¾-in. block in my case at home, but have found ½-in. blocks better for other types of alarm clocks. The front frame is glued to this filler piece and it, in turn, is nailed to the bottom of the case.

A small piece of brass at the back holds the roof together and provides means for hanging the case up. The handle is ¾ in. thick but can be made of ½-in. stock. The completed case is stained and varnished.—ERNEST I. C. ERLANDSON, Alameda, Calif.

Repairing Camera Bellows

ZIGZAG marks or patches sometimes found on films taken by amateur photographers are very often due to small holes in the bellows of a folding camera.

To locate such defects remove the back of the camera and hold it up to the sun, with the shutter closed and place a black



The minute holes are patched with adhesive tape

cloth over your head to exclude the light.

Cover the hole or holes when found with adhesive tape or plaster, preferably such as is used in medical work, and blacken the patch with India drawing ink applied with the filler quill or a small brush.—EDWARD H. FLAHARTY, Denver, Colo.

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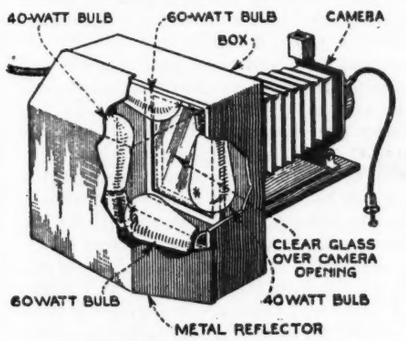
Simple Light Box Adapts Camera for Making Enlargements

ARTISTIC enlargements can be made with this simple light box because it gives time for intercepting and manipulating the light where necessary. I have found it particularly useful in bringing up 2¼ by 3¼-in. pictures to 8 by 10 in. In fact, I have enlarged from ½ in. to 10 in. with an exposure of from four to six minutes.

Only light that is diffused and equalized by the reflector passes through the film and into the camera, no opal glass being used.

The light box is a frame of wood slightly wider than the width of a 60-watt lamp. The front is closed except for an opening the size of the camera back, to which is fastened a carrier in which the negative slide is



Using reflected light only, this simple enlarging device is slow enough to allow the manipulation of lights and shadows

placed. This tube fastens to the camera in the same manner as the back ordinarily is attached; that is, the light box opening is made to suit the opening in the back of the camera, so that the camera slips on at one end and is clamped over the other.

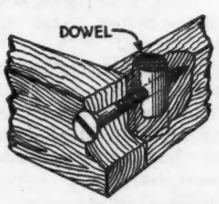
The reflector is a square ten-cent pan about 2½ in. deep, opened out sufficiently so that its edges rest on the box; they are then nailed down over felt strips. The inside is painted with aluminum paint or white enamel. The source of light is two 60-watt and two 40-watt lamps, giving a total of 200 watts. The lamps must not, of course, be connected in series nor arranged so that the filaments show through the opening.

I have added a red light on the top of the box, so that at no time is the studio completely dark. The wires connecting the lamps may be run either in or outside the box, the latter being the easier arrangement.

The manipulation is the same as with any enlarging camera. At 3 ft. the exposure is about three minutes with ordinary bromide paper, and that allows plenty of time for screening.—M. C. EVERETT, Chicago, Ill.

Dowel Forms Anchor for Holding Screw in End Grain

THE difficulty of making wood screws hold permanently in end grain is well known to all woodworkers and for that reason a dowelled, a mortised, or a dovetailed joint is the standard construction. A screwed joint of this end-grain variety is sometimes essential, however, because of the necessity for occasionally taking the joint apart. In such a case the screw can be made to hold by inserting a dowel as shown.—G.



A strong screwed joint

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How to Rebuild an Old Car

(*Continued from page 75*)

front wheels. Jack up each one and then, grasping the top and bottom, rock it in and out. This shows the play in the wheel bearings and the wear in the pivot pin bushings. Also inspect the tie-rod clevices to see whether they are in good condition. The ball-and-socket joints on the drag link and steering gear arm should also receive attention.

By taking the wheel and noting the amount of turn before the front wheels are affected, you can determine the play in the steering mechanism. If it will turn as much as a quarter turn, be careful, for it may be impossible to adjust it enough to make steering safe.

By this time the owner is getting pretty impatient and you had better let him take you for a ride. Sit with the driver. He starts out fine, and then, just to show you how much power he has, he opens the cutout. If he gets into gear without scraping and rasping, you may say the clutch and the clutch throwout are in fair condition.

You breeze down the street and over the little hill like a house afire. Ask him to close the cutout so that you can hear the engine and gears. Is there a growl in the rear axle gears? Maybe they need adjusting. Pull off the inspection plate when you get back and see if there are any pieces broken out of them; if not, you can adjust them to quiet them.

Running Slow in High Gear

Have the driver slow up a bit so that you can see how slow the car will run on high. Seven miles an hour! That is too fast for a six. Shut off the gas entirely and retard the spark a bit. Five miles? That is better. Four miles? Still better. Put on the brake a bit. Better yet, but she misses a little. Possibly a weak cylinder or bad contact points, or it may be wiring or carbureter. It is hard to say, but even four or five miles is good for an old six. When she is overhauled, she will come down to one or two without missing.

Now have your driver take you over a long hill. He may seem a little anxious to take it at a run, but ask him to go slow and put her in second. You see, that second speed gear may be worn tapered and if it is, he will not keep her in gear.

A long hard hill in second tests the cooling system. As soon as you are over the hill, stop and give another look.

What is that rumble? Could it be water boiling? Take off the radiator cap. Sure enough, she is boiling. Maybe a bad hose connection or a stopped radiator core.

Back at the garage talk price a little and inspect tires, top curtains, paint, battery, and other parts here and there.

"Well, I will look a little farther," you tell the owner, "and call you up in a day or two."

After inspecting several more cars, you decide to make one of the owners an offer. You know what you want to put into a car and have an idea of what it will cost to put this one in condition. With that in mind, you are in a position to make an intelligent offer.

With your purchase at home in your own garage, you start dismantling it. You expect to make a good job of it—not just a case of something that will run, but rather something you know from radiator cap to tail lamp. So take off the top and

(*Continued on page 115*)

How to Rebuild an Old Car

(*Continued from page 114*)

place it away and remove the body, having first dismantled all fenders, aprons, wiring, and other connections that might interfere with lifting it. Next, remove all tires and rims and then run the chassis out where you can take a paint brush with stiff bristles, a putty knife, and several gallons of kerosene to clean the exposed parts.

There is real fun in overhauling the bus, but no one likes to be dirty all the time. So clean it and have done with the road oil and general grime and dirt. The glisten of the aluminum crankcase alone repays you for the effort.

Now, I shall have to leave, but if you will get that chassis really clean before you go any farther, I will lay out a few jobs for you:

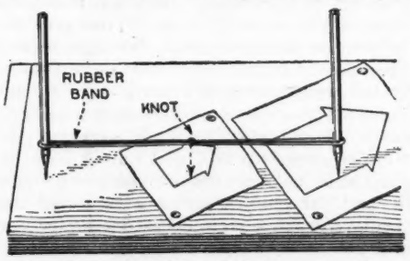
1. Clean chassis.
2. Remove all units from the frame.
3. Inspect frame for cracks, loose rivets, and bends.
4. Renew all bushings in springs, if the old ones are badly worn.
5. Graphite all spring leaves after taking them apart and sanding them to remove rust. Reassemble springs.
6. Rebush the pivot pins and the tie rod yokes. Inspect and overhaul the front axle.

I will return next month to see how clean you have the chassis and whether you make a good job of the new bushings. Then we will take up the work of overhauling the rear end, the transmission and clutch, and, if we have time, the engine itself.

Enlarging Sketches with Rubber Band and Pencils

THERE are a number of ways of enlarging or reducing sketches, but the simplest method that I know is the one illustrated below. An ordinary rubber band and two pencils does the trick, or a rubber band, a lead pencil, and a pen.

Put a knot in the rubber band close to the center, as shown. If the knot is made exactly in the center, the enlargement will be twice the size of the original; by placing



The knot in the elastic is kept constantly over the line being copied by the right-hand pencil; the left-hand pencil remains stationary

the knot one third of the distance, the enlargement will be 3 to 1; one fourth, 4 to 1.

The rubber band is placed around the pencils, and one pencil is held stationary while the other pencil is used for making the enlarged drawing. The direction and length of the line are regulated by watching the knot, which must be kept exactly on top of the line that is being copied.—W. F. SCHAPHORST, M.E.

TO AVOID bubbles in varnish, never shake a varnish can before pouring, and pour the varnish with the outlet uppermost.

Yes—why don't you?
WELL—NOW
WHAT!!!!
A BULLY CONCERT AN' IM NOT IN ON IT! O MY!!
TA-RA-TA-TA COME ON NOW MR. SOUSA—IM READY
NOT A RATTLE
O, BLA-A-A AN' NOT A SIGN O' JUICE
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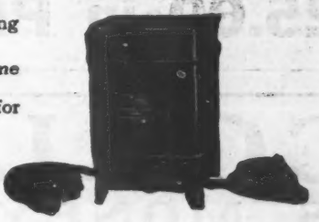

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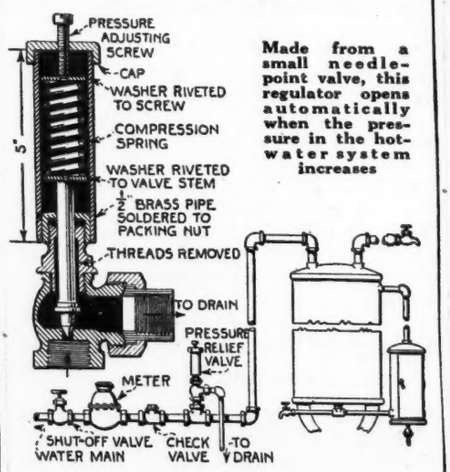
Hot-Water Relief Valves Prevent Waste and Leaks

By John H. Schalek

ASIDE from corrosion, the greatest annoyance experienced by the householder is that of leaking joints in the so-called "closed system" of water heating. In this system there usually is a check valve, which prevents the hot water's backing into the meter and damaging the hard rubber parts.

Because of the check valve, the accumulation of heat in the water at such times when little or no water is used, raises the pressure in the piping and tank to an alarming extent. An increase in water temperature from 60 to 100° F. may bring the pressure in a closed system up to 240 lbs. a square inch, assuming an initial water pressure of from 60 to 70 lbs. This is more than twice the pressure that the average hot water tank is designed to withstand. As soon as a faucet is opened, the pressure immediately drops to 60 or 70 lbs. Building up and releasing this abnormal pressure several times each day cannot but have a damaging effect on the whole system and usually is the cause of leaks.

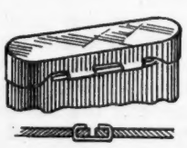


Made from a small needle-point valve, this regulator opens automatically when the pressure in the hot-water system increases

Fortunately, in many cases there are sufficient leaking faucets to act as a safety vent for this pressure. Only a few drops a minute are required to keep the pressure below the danger point. To release this pressure automatically, the device illustrated was developed from a needle-point valve having a ⅛-in. valve opening. The screw thread was filed off, allowing the stem to move up and down freely.

As soon as the pressure reaches a point beyond the counteracting pressure of the spring, the valve stem is lifted from its seat and the excess water discharged from the system. The amount of water is insignificant, but when the device is in use, the pressure in the water heating system may be kept almost as low as the city pressure.

Joining Sewing-Machine Belts



IN REPAIRING a broken sewing-machine belt, the home mechanic often has difficulty in finding a piece of soft wire the right size to bend into a connecting link. A length of No. 16 or No. 18 gage soft iron wire of exactly the proper size can be obtained by tearing off the cover of an old tobacco tin of the type shown and using the hinge pin.—W. B.

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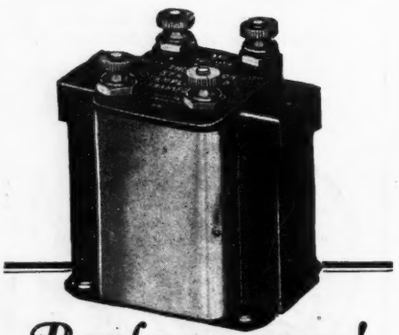

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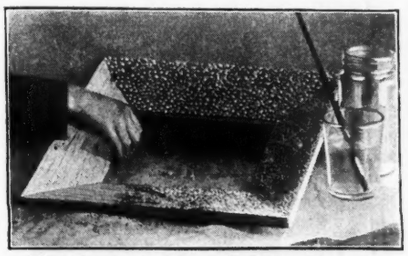
Gilded Picture Frames Made without Special Moldings

TO MAKE gilded picture frames without rabbeted molding or any expensive materials is not particularly difficult. The stock for the frames should be ⅛, 3/16 or ½ in. thick and 2½ in. wide for small sizes, and ¼ or ⅜ in. thick and 3 or 4 in. wide for larger pictures.

Cut the angles not a true miter but a little less than 45 degrees, so that when the sides

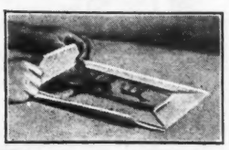


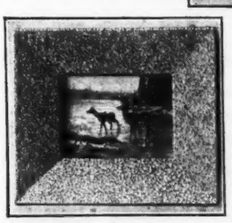
The frame is painted with glue and barley, rice, or other grains are spread thickly over it

are glued and nailed together, they will slant inward a trifle. The slope should be noticeable but not too pronounced.

When the frame has been assembled, spread glue over its outer surface and outer edges, and while it is still wet, sprinkle rice over it to form an uneven and slightly wavy surface. When dry, this surface is gilded with metallic paint—gold, bronze, or

Mounting the picture on the glass (at right). The framed picture (below)





silver. If desired, the rice can be arranged by the use of a stencil to form an ornamental design, and the contrast between the various parts can be heightened by using grains of various sizes.

If the picture is a printed one, moisten it on the back with water, spread it carefully on clean glass of the proper size, lap the waste edges over the glass and glue them in place. A photograph is mounted on cardboard and the cardboard is glued to the glass with strips of paper. An oil painting is mounted on cardboard and treated in the same way, but if on a stretcher, it can be fastened to the frame directly with brads.

"Junking" an Old Auto

YOU can often obtain more money for an old car if you "junk" it yourself than if you sell it intact to a junk dealer. Wreck the machine and separate the various kinds of metal. Sell the metal as scrap, and whatever is too bulky to get rid of in this way, dispose of to the junkman.

If you haven't time to do the job yourself, make a deal with some boy to do it for you.

In one case no dealer would offer the owner more than $15 for the entire machine. Finally he "junked" the car himself and sold the metal and scrap for approximately $60.—G. W. GREENE, New Bedford, Mass.

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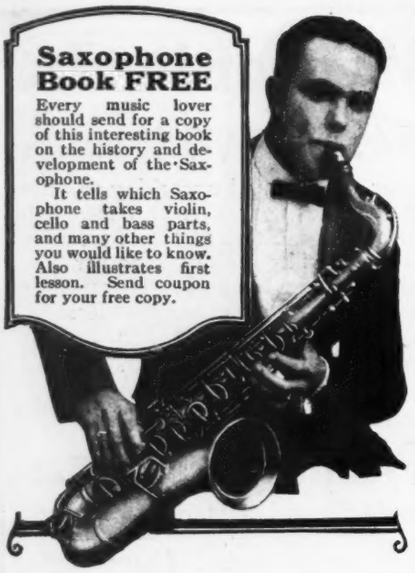

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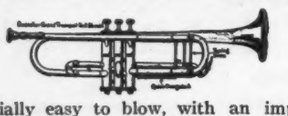

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(*Continued from page 42*)

land. In the water they could merely drift about and settle anywhere until the bottom was peopled. On land they are fixed. In the partition of advantages between plants and animals in the very beginning, plants had received the great advantage of self-feeding, but they gave up to the animals the advantage of voluntary motion. How, then, could they contrive to extend themselves on land until they conquered all of it, even the parts that are farthest from the sea?

The doing of this has involved what botanists call the means of dispersal, the way, that is, by which a certain kind of plant can extend the region in which it grows. This had begun even before the invention of seeds. Some ferns, for example, possess a kind of running root that creeps out underneath the soil and comes up many feet away to make new plants. Again, it was one of the original advantages of the alternation of generations that the smaller plant of the two might blow off somewhere in a wind or float about on the water and thus start a new colony of its kind.

How Seeds Are Dispersed

But none of these means was very rapid or efficient and real success in this problem of dispersal came only after the seed (and certain similar devices like the spores of mosses) had been perfected. A seed, obviously, can go a long way safely if you can get something to carry it, so plants have devised several such carriers. Some seeds, for example, have fluffy fibers on them like the seeds of thistledown. Others have wings like the seeds of the maple tree. These are aviation devices, ways to get seeds carried off more or less distantly by the wind. Then there are floating seeds that can make long voyages by water, and there are sticky seeds and seeds with fuzzy coats so that they get stuck fast to the skins or fur of animals.

But the most successful device of all for the dispersal of seeds was the device of persuading some animal to eat them. This is the reason for fruits. If you like apples, you may carry some of them off a long way from the tree, and when you finally eat them, you will scatter the seeds wherever you happen to be. Other animals do the same.

Some Plants Eat Meat!

Plants seem, too, to be casting longing eyes at the other peculiarities of animals. Some of them, like the familiar sensitive plants of the greenhouses, have developed a considerable power of moving parts of their bodies. The leaves of this plant close up almost instantly if it is touched or shaken. Others covet, apparently, our prerogative of animal food. There are several kinds of plants that catch unwary insects in traps of various sorts and thereafter digest and assimilate the insect bodies.

A very curious one of these plants that we illustrated in the first chapter of this serial is the Venus fly-trap. It possesses both the power of motion and the ability to eat flesh. Its leaves are in two halves like the two covers of a book. If an insect enters between these leaves, they close and the insect is trapped, killed, and digested.

But these small triumphs of the vegetable

(*Turn to page 119*)

U.S. PATENTS

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Wreck survivors

Our Silent Partners

(*Continued from page 118*)

world over the animal one, we, as animals, can afford to ignore in the light of the havoc that we have worked on plant life for the purpose of agriculture.

Plants that survived the difficulties of escaping from the sea, that fitted themselves successfully into all the climatic vicissitudes of half a billion years, have yielded, at last, to the spirit of man. Man has made over, in large degree, the vegetation of the world. Some plants, such as the forest trees, he has removed bodily from millions of square miles. He has put other plants in their places, merely because he happens to like them better or because he needs something that they produce. An obscure grass, for example, that grew sparsely on the mountains of Lebanon twenty or twenty-five thousand years ago now grows all over the world. It occupied nearly 100,000 square miles of the United States last year. The name of it is wheat.

Man Has Created Some Plants

This is man's doing, not Nature's. Who can say where it will stop? Man, as we said last month, has entered even into the realm of evolution. He has created plants that Nature never thought of. This may be, indeed, the solution of the pressing problem of human food.

Agriculture is not only the most ancient art, it is the art conducted most completely in the antique fashion. Plowing, for example, is still in all essentials, except labor, exactly as it was 6000 years ago. We know very little of the real chemistry of the soil or of the things, chemical and biological, that happen inside the bodies of growing plants. As the scientists learn more of these things, we may be able not only to induce two plants to grow where but one grew before, but to procure from one plant twice or three times or 10 times as much food as it is accustomed to yield. We have already done this for many grains and fruits. Compare, for instance, the wild apple and the cultivated one.

There is the possibility, too, that we may be able to duplicate artificially the process of photosynthesis by which plants use sunlight to make food, an enterprise upon which a committee of distinguished American scientists is now engaged. Success in this would make animals independent of plants for the first time.

It may happen so; it may not. We cannot foresee. But one thing we may be sure of: the problem of human food must be solved somehow. Life has overcome too many difficulties in the past to be dismayed in the end, by this.

¶ Next month—Matter and Energy—What atoms are and why they are the great potential source of power in the universe—How science is attempting to harness this power.

FOR FURTHER READING

AMONG good books on plant life is "The Living Plant," by W. F. Ganong (Henry Holt and Co., New York, 1913). An excellent short account of the evolution of the plant kingdom is "The Evolution of Plants," by D. H. Scott (Henry Holt and Co., New York, Home University Library, 1911). The scientific student will find an excellent summary of modern researches and many references to further literature in "Plant Physiology," by V. I. Palladin, Second American Edition, edited by B. E. Livingston (P. Blakiston's Son and Co., Philadelphia, 1922).

NOTE: The photograph of the ancient Babylonian tablet, published in the August chapter of the series, should have been credited to the University Museum, University of Pennsylvania.

Carries Great Messages Around the World

THAT statement adequately expresses what is perhaps the greatest influence of radio in developing and bettering human fraternal interest, not only between the people of one community, of one country, of one state, or even a single nation, but between all nations and all peoples of the world.

Be these messages from government leaders—from the heads of the world's greatest educational institutions or from those who stand foremost in the arts of the world—they will serve to bring the human race into closer contact.

In the past ages great orators and writers, famous poets and musicians have swayed the destinies of nations, and have been instrumental in the rise and downfall of mighty empires.

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C-11—1.1 Volts .25 amp. Dry Battery Det. and Amp. Special Base. 6.50
C-12—Similar to C-11 with Standard Base 6.50

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Wreck survivors tell how tobacco kept them going

When food and water gave out on third day, they smoked until rescued

Perhaps they were only pirates of the sea. Nevertheless, they were very much human beings when they found themselves miles out to sea adrift in an open boat.

With two days' supply of food and water, they confidently expected to be rescued in plenty of time. But when the third day passed and no friendly sail appeared on the horizon, it began to look like a case for Davy Jones's locker.

One of the victims, crazy with thirst, suggested that they divide a bottle of iodine and end the agony quickly.

"The tobacco hasn't given out yet," said another. "Let's stick it out a while longer." And they did.

Late in the afternoon of the fifth day a tramp schooner saw their distress signals and came valiantly to the rescue.

"The only thing that kept us going at all was tobacco," one of the survivors admitted when he was safely deposited on dry land again.

Pipes filled with Edgeworth probably have no more soothing effect than pipes filled with other tobaccos, but most Edgeworth smokers feel that they need Edgeworth to get complete pipe satisfaction.

If you have never smoked Edgeworth, send your name and address on a post-card to Larus & Brother Company. They will be glad to send you free samples—generous helpings both of Edgeworth Plug Slice and Ready-Rubbed.

Smoke a few pipefuls and judge for yourself whether or not you wish to become a permanent member of the Edgeworth Club.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Ready-Rubbed are packed in small, pocket-size packages, in handsome humidors holding a pound, and also in several handy in-between sizes.

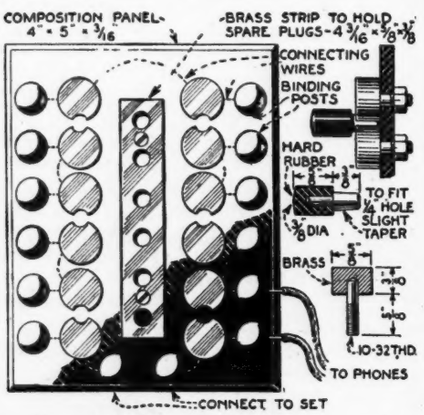
For the free samples, kindly address Larus & Brother Company, 59 South 21st Street, Richmond, Va. If you will also include on your postcard the name and address of your regular tobacco dealer, your courtesy will be appreciated.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

Plug Switchblock Gives Easy Control of Radiophones

THE radio fan who prizes neat and unusually efficient apparatus will find the switchboard illustrated an excellent means for controlling the connections of his loudspeaker and telephone headsets. Five pairs of phones and a loudspeaker can be plugged in or out at will without changing any connections.

The base is a 3/16 by 4 by 5 in. composition panel. The connectors are 12 pieces of 5/8-in. brass rod. The head of each is 5/8 in. in diameter and 3/8 in. deep, with a threaded stud or a separate stud provided, as shown, from a length of 10/32 threaded rod. It is just as well to mount these connectors first on a wooden templet the same size as the composition panel. Place the connectors so that there will be 1/16-in. clearance between the units of each pair, and 1/8 or 1/4



How the switchblock is laid out, and the plugs and connectors are made

in. between the pairs. When the studs have been locked tight with nuts, drill 1/4-in. holes between and through the heads of each pair, as shown. A piece of brass 3/8 by 5/8 by 4 7/8 in. should also be drilled with the same size holes to hold the plugs when not in use.

The plugs should next be turned, as indicated, to be a snug yet not too tight a fit in the 1/4-in. holes. A slight taper is desirable. Hard rubber handles about 3/8-in. in diameter and 5/8 in. deep should be prepared for the plugs, but not fitted to them until they have been nickel plated and polished at a plater's or jeweler's.

While this is being done, use the wooden templet for marking and drilling the composition panel. Drill holes for the binding posts, bevel the edges, and give a satin finish with fine emery paper. The nickel-plated parts are then attached and the hard rubber handles fitted to the plugs.

The connections are made at the back, as shown by the dotted line, and the panel can be fastened to a hardwood block, recessed to take the projecting nuts and wires. The edges of the block should be polished.

In use, the loudspeaker and telephone are connected with the various binding posts and the receiving set is connected with the terminal binding posts. To plug in the loudspeaker or any particular pair of phones, simply remove the plug from between the corresponding connectors and place it in the holder.—LESLIE GREENSLADE, Hamilton, Ontario, Can.

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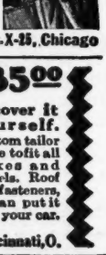

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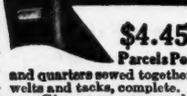

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EVERY sportsman occasionally wishes to test the accuracy of his rifle sights. In doing this easily and quickly, the gun rest illustrated is a distinct aid. It reduces the "human element" to a minimum, and, by using it for several shots, the grouping on the target will show up any marked deviation to right or left, or high or low.

The standard for the rest is a well-built sawhorse, the legs being mortised into the

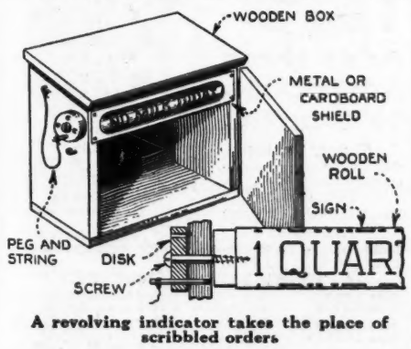
How the gun rest is made and used to adjust rifle sights accurately

4 by 4 in. saddle at an angle. On the forward end of the horse an upright is dovetailed, so that it will slide as required, and at the same time be quite rigid. The upper end of the upright is notched to receive the gun barrel.

Just back of this upright an adjustable beam is hinged and into it is dovetailed a second upright, also notched to support the gun. Near the end of the horse is an adjusting screw for raising or lowering the hinged beam when sighting the rifle on the bull's eye.—LEROY W. HUTCHINS.

Changeable "Note" for Milkman

THE addition of a revolving indicator to a milk-bottle box makes it unnecessary to write notes to the milkman when extra quantities of milk and cream are desired. The wooden roll, made from an old curtain pole, is mounted so as to revolve easily near the top of the box. A wooden disk, about ⅜ in. thick, cut from the same curtain pole, is fastened tightly to one of the pivot screws on the outside of the box.



A revolving indicator takes the place of scribbled orders

Several holes are drilled through this disk, and one hole for indexing is drilled into the side of the box, so that a peg may be used to fasten the disk in any of its positions.

The roll itself is covered with a sheet of white paper on which the desired orders are lettered with waterproof drawing ink, one order corresponding to each index hole. A mat cut from galvanized iron, tin, or even cardboard is fastened to the box to serve as a frame for the roll.—KARL L. MARTIN.

Your "Greater Self" never Sleeps

DID you ever feel that you were being directed, at a crucial moment, in an important task, or when making a momentous decision, by some intelligence and power vastly greater than yourself?

Did your heart ever grow sick of the daily grind and the dull drab prospect of all the days and years ahead? And then did you experience an inspiring flash of thought, amounting almost to whispered words, that a higher, nobler and happier life was possible to you—that it was within your power to make your life anything you wanted it to be?

If either of these experiences ever came to you, did you wonder whence the inspiration came? It was your Greater Self whispering to you, and urging you on to become and achieve the things you wanted to become and achieve. You actually have a Greater Self. It occupies four-fifths of your brain. It never sleeps. It built your body from the beginning, and still sustains, repairs and renews it. It is your God-Mind. It is timeless, and changeless, and deathless, and abundantly able to give you every desire of your heart.

Although I am actively engaged in high judicial work, I have found time to prepare a personal manuscript message entitled "Realization," which has introduced a great many men and women to their Greater Selves, and since that introduction they have healed themselves of stubborn diseases, come into possession of the things they desired, succeeded abundantly in business and professional life, attained love and happiness, and come into a calm peacefulness of mind which passes understanding. I will be glad to send you a copy of "REALIZATION" fully postpaid and

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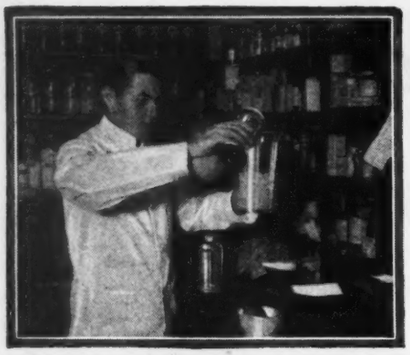

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Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

CEMENTS and glues can be used for the most diverse purposes in the home workshop. Some are water resistant, others fireproof, and others useful for joining either similar or dissimilar materials.

An effective cement for many substances can easily be made by soaking one part of glue in an equal quantity of water. The glue is removed before it has lost its primitive form, and the swollen mass is then dissolved in one part of linseed oil with the aid of heat until a jelly is formed. This joins wood tightly and is practically waterproof.

Finding that the continual reheating of glue is often troublesome, especially if small quantities only are required, I make a simple liquid glue. Although not as strong when dry as a glue especially prepared for a given piece of work, it serves the purpose about as well, especially for the small jobs that constantly require attention in every household.

One part of sugar is dissolved in three parts of water, and for each tablespoon of sugar used, ¼ teaspoon of burnt or slaked lime is added. The solution is then slightly heated, not boiled, and, when cold, decanted from the sediment, which is thrown away. Dry carpenter's glue is dissolved in the liquid by putting in a few small pieces first and adding others until the glue has a syrupy consistency when cold. Should it become too thick, a little more of the sugar and lime water is added.

Mixing glycerin-litharge cement

This is a fine glue for ordinary small jobs and suitable even for delicate inlays if gelatin is substituted for the carpenter's glue. It then becomes a transparent, colorless mucilage.

A glue that has received much attention lately, because it is widely used in aircraft work and automobile body construction, although a glue that even the ancient Egyptians used for their remarkably enduring cabinet work, consists largely of casein. Casein, which is nothing more than the curd of milk, can be obtained by slightly warming fresh milk to which a little acetic acid has been added. The precipitate is filtered through a cloth and washed. One part curds to four parts of water are stirred together until no lumps remain; a little ammonia is then added and the glue is placed in a pan of hot water and thoroughly stirred. It can be used cold like any mucilage.

A cement of glycerin and litharge is so hard that it can be removed only by being chopped out with a chisel. A pound of finely ground dry litharge is thoroughly stirred with 1½ oz. glycerin, or in similar proportions. Use as soon as mixed, first rubbing a little viscous glycerin over the surface of the materials to be joined. The job must be finished within 15 minutes, as the mixture solidifies after 20 or 30 minutes.—ERNEST BADE, Ph.D.

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are equipped with ear caps that cover the ears—excluding outside noises.

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The adjustment rod telescopes and therefore does not catch the ladies' hair.

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Type-A-737 (300-700 meters) 6 inches square—non-directional $10
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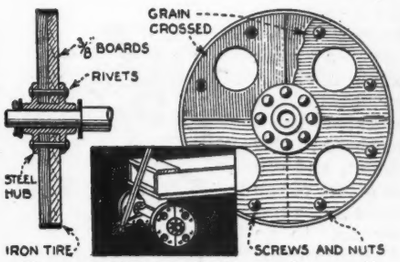
Making Wheels for Coaster Wagons and Teacarts

A SET of wheels for a homemade coaster or toy express wagon, or even for a teacart, can be built quite easily by the method illustrated. The steel or iron hubs are turned up with double flanges, the width of the space between the flanges being equal to twice the thickness of the wood that is to be used. For small wagons and teacarts ¾ in. is thick enough.

For light axles ½-in. square iron is used, the journals being turned to 7/16 in. in diameter.

The wooden part of the wheel is made by using 4 pieces of dressed lumber, 2



These excellent substitutes for small commercial wheels are made mainly of wood with metal hubs and tires

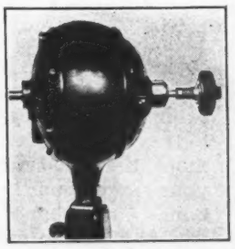
pieces to a side. The grain of one pair should come at right angles to that of the other. Small rivets or bolts are used to fasten the hub and wood together. The wooden parts are also bolted together around the rim with ⅛-in. screws and nuts, and the wheel finished either by turning or by sawing carefully to shape and filing.

A tire of ⅛ by ¾ in. iron is slipped over the wheel and fastened with a few sprigs or nails. The wheels can either be left solid or have large holes bored through them, as shown.—J. R.

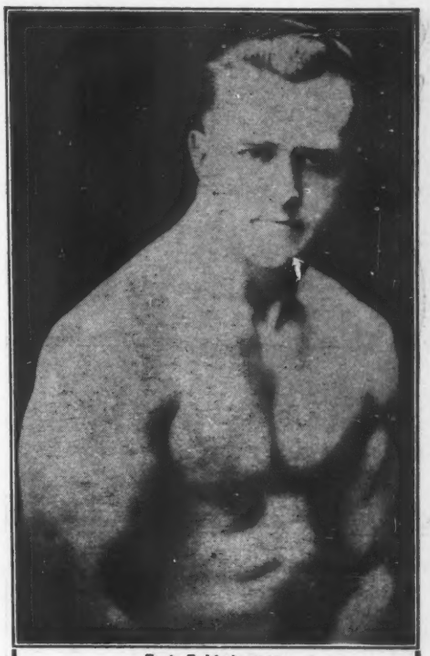
Fan Motor Runs Emery Wheel

NO HOME worker need be without a motor-driven emery wheel, at least during cool weather, provided he has an electric fan. The fan can be removed and a small wheel attached directly to the motor shaft by means of what is known as a "jeweler's chuck." Small wheels can be obtained at any hardware store, usually for about $1. The softer grades of wheels, desirable for sharpening the finer tools, such as chisels and knives, can generally be had at any jeweler's supply house.

If it is desired to make a chuck, as in the fan motor grinder illustrated, use a piece of brass or other pipe, about 1½ in. long and of a diameter to fit snugly over the motor shaft. Next obtain a machine screw that will fit inside the pipe and cut off 1½ in. Slide the cut end halfway inside the pipe and solder it securely, being sure that it is properly centered. Then solder a large iron or brass washer against the end of the pipe to serve as a flange, and make a heavy fillet of solder to reinforce the joint. Fasten the pipe to the shaft with a setscrew and hold the wheel on with locknuts.—J. G. Pratt.



Using a fan motor as a grinder



Earle E. Liederman as he is today

Pills Never Made Muscles

Wishing Never Brought Strength

NO one can paste muscles onto your arms and shoulders. If you wish a strong, healthy body, you must work for it. And if you don't have one, you are doomed to a life of misery.

Modern science has taught us that we must keep our bodies physically fit or our mental powers will soon exhaust themselves. That is why the successful business man resorts to golf and other active pastimes.

Examine Yourself

Do you have the strong, robust body which keeps you *fit* at all times to tackle the daily tasks confronting you—always looking for bigger things to do? Do you jump out of bed in the morning full of pep; with a keen appetite and a longing to enter the day's activities? Do you finish your daily tasks still thrilling with pep and vitality? Or do you arise only half awake and go through a languid day?

PEP UP!

Don't let it get you, fellows. Come on out of that shell and make a real *he* man of yourself. Build out those skinny arms and that flat chest. Let me put some real pep in your old backbone and put an armor plate of muscle on you that will make you actually thrill with ambition. I can do it. I guarantee to do it. I will put one full inch on your arm in just 30 days and from then on, just watch 'em grow. This is no idle boast. It's the real works. A genuine guarantee. Come on now. Get on the job and make me prove it.

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THIS proves how well Ole Evinrude has protected the Elto light twin against the greatest cause of wear and breakage—the distortion and disalignment of the drive shaft due to striking under-water obstacles. In addition to safety-tilting, the Elto is protected with full floating type drive shaft construction—making shaft distortion or disalignment absolutely impossible.

This exclusive feature, together with the fact that the Elto has double the bearing area of any other lightweight outboard motor, and that its crank and drive shafts are case hardened, finely ground and heavily plated, beyond all question gives the Elto the longest, trouble-free service life.

Speed!

RECENT British Motor Boat Club International Regatta on the Thames—one Elto entered against European and American outboard motors of all weights and horsepower, *Elto wins first place—and prize* for covering course in fastest time.

Pacific Coast International Regatta—three mile course in rough open sea. Elto wins *first and second* prizes against competitive motors of all weights and power.

No obscure races these! Both important International events that prove beyond question the supreme speed of the Elto!

The Elto is the most powerful light weight motor, the lightest motor per horsepower. It starts as easily as striking a match because it has a big hot spark independent of cranking speed and for the same reason it can be slowed down to real fish-getting trolling speed. Rudder steering. No dangerous pivot turning! Tiller rope control from any part of boat. No shaky, vibrating steering handle. The only 3 H.P. light weight motor—a full *extra* horsepower over other lightweight motors, the needed H. P. for substantial boats—to buck wind, waves, currents and tides or sudden storms.

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The Shipshape Home
How to Do the Odd Jobs

How to Drive Screws

BEFORE screws are driven in any but very soft woods, holes should be bored as deep as the shank of the screws. In hard woods, these first holes should be the exact size of the screws. Then a size smaller bit or drill should be used to the full depth of the screw or nearly so.

Do not try to force in a screw by main strength. You may have the screw break off and give much trouble. Take it out and bore a larger or longer hole. Carry a little soap in the hammer handle, as suggested last month in this column, and dip the points of the screws in it when they are to go into hard woods.

Countersinking in hard wood

In common work, such as making batten doors, some carpenters and many amateur mechanics hammer screws right through the battens. That is not good practice, since the work cannot be drawn up tight or the screw heads turned in flush.

Many old screwdrivers give much trouble because they constantly slip while being used. This is because the point has been ground or filed at too sharp an angle. A screwdriver should have a very gradual taper toward the point, and the closer it fits in the slot of the screw, the easier is the work.

Use a countersink bit for hard woods and put it in just the right depth for the size of the head of the screw used, and no more. In all fine work, especially in fitting hardware to cabinets and furniture, and in fastening radio panels and the like, leave all the screws with the slots perpendicular. Space the screws carefully whenever the choice of spacing depends upon you.

A screwdriver bit for the brace is often useful, as it is a strong and speedy tool for large screws. If a large number of screws are to be driven, much time may be saved by using one of the many quick-acting drivers on the market.—A. E. ELLING.

(*Continued on page 125*)

Dollars for Ideas

IN KEEPING your home shipshape, you often hit upon ingenious, time-saving, labor-saving and money-saving ideas.

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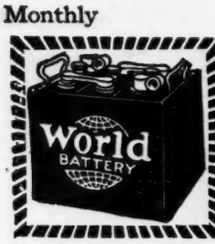

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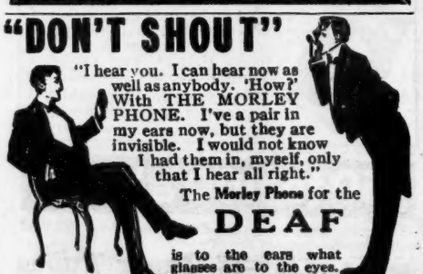

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The Shipshape Home

(*Continued from page 124*)

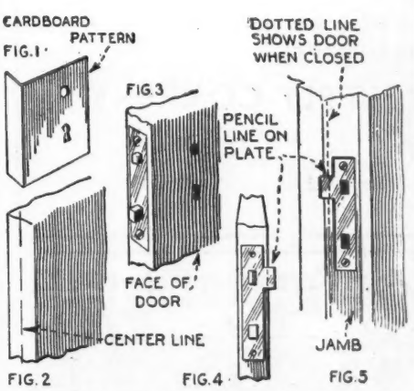
Fitting Mortise Locks

To FIT a mortise lock in a door is a problem that confronts at some time or other almost every home worker. It can be done quite easily and with perfect accuracy if the proper method is used.

Even for one door it is advisable to make a pattern, as shown in Fig. 1, from a part of the cardboard container in which the lock was packed. If a number of locks are to be installed, a pattern is, of course, a great time saver.

Next, locate the position of the lock by placing an escutcheon plate on the door. There is no standard height today, some authorities preferring a high handle and others a low handle. If undecided, arrange the escutcheon about 3 ft. above the floor. An inch or two either way will not matter, if it is desirable to place the knob so that it comes opposite the center of a rail or a panel.

Place the lock pattern on the door and mark both face and edge. Bore holes for



How to lay out and fit the mortise lock and its striking plate quickly and accurately

the handle and the top of the keyhole, using a ½-in. bit for the handle and a 5/16-in. bit for the keyhole.

Draw the center line on the edge of the door, as shown in Fig. 2, and with an 11/16 or ¾-in. bit bore a series of holes the full depth of the lock. Place the holes as closely together as possible, and then clean out the wood with a long, narrow chisel and a wide one. Finish the keyhole with a compass- or keyhole-saw. Insert the body of the lock in the mortise and mark around the faceplate with a sharp knife. Cut a recess within these lines sufficient to allow the faceplate to go in flush, as in Fig. 3.

Next, take the striking plate and place it on the lock, as in Fig. 4, and make a pencil mark on the projecting portion of the plate, in line with the face of the door. Take off the striking plate, close the door, and make another pencil mark along the face of the jamb in line with the edge of the door.

Now, place the striking plate on the jamb with the short pencil line on it in line with the pencil mark that has been drawn on the jamb, as in Fig. 5. This insures the striking plate's being in just the right position, provided a mark has also been made to fix its height correctly in relation to the latch and lock.

The striking plate is let into the jamb and nothing remains but to put on the handles and screw the escutcheons in place.

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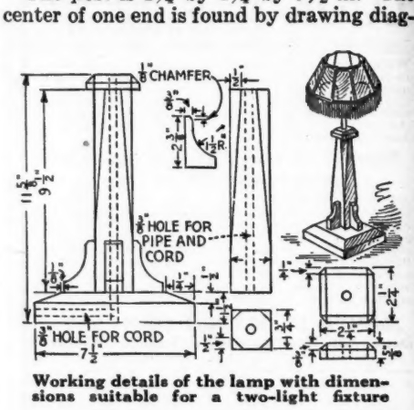
Craftsman Lamp for Library Table Is Easily Made

SIMPLE in design and not difficult to make, the oak lamp illustrated below is intended for use on a mission or "craftsman" library table. The shade may be of silk or parchment, or constructed of wood and stained glass in the home workshop. The lamp is proportioned for a two-light fixture.

The base is a 7½-in. square of 1½-in. quartered oak, with a ⅜-in. hole bored through the center. Another ⅜-in. hole is bored, preferably with a doweling jig, from one edge of the base to meet the central hole. The base is then chamfered, the ends being finished first to avoid chipping and splintering.

The post is 1¾ by 1¾ by 9½ in. The center of one end is found by drawing diagonal lines between the corners, and a ⅜-in. hole is bored the entire length. The chamfers, which run out 2⅜ in. from the lower end, are then planed accurately.



Working details of the lamp with dimensions suitable for a two-light fixture

The top is made by squaring a piece of ⅝-in. oak to 2¼ in., sawing off the corners and chamfering the edges. It is bored with a ⅜-in. hole. The four braces are cut from stock ¾ by 1½ by 2⅜ in. The curve is cut on a band or jigsaw, or with a coping saw, and the ⅛-in. chamfer planed as indicated.

All the parts should next be scraped and sandpapered. The post is fastened to the base by means of two No. 10 bright 2½-in. wood screws, so placed as not to block the cord hole. The top is fastened to the post with glue and finishing nails, and the holes are plugged with stick shellac. The braces are glued in place.

Any method of finishing may be used. Usually it is best to match as nearly as possible the finish of the table on which the lamp is to stand. The wire and fixtures may be obtained in any electrical store and will be found very easy to install.—KENNETH R. LAVOY, Hudson, N. Y.

FEATURES FOR NOVEMBER

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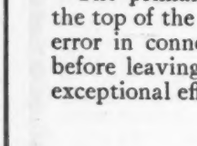

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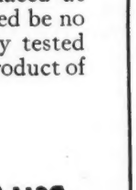

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St. Louis Man Discovers New Kind of Heat!

Amazing New Invention Does Away With Dirty Coal and Wood

No more fires to build, bank or watch—no more dirty, heavy coal to carry and lift—no more clouds of ashes to breathe, or back-breaking scuttles to empty—no more heating problems—no more cold rooms in Winter—no more suffering from lack of quick fires in uncertain Fall and Spring—no more worries about coal shortages, poor quality or high prices since this Wonderful New Invention.

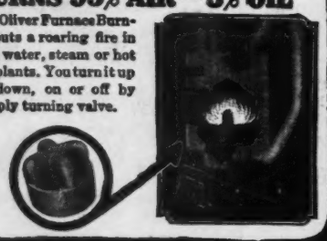
For Every Heating Purpose

No coal—no wood. No dirt — no ashes. The Wonderful Oliver keeps rooms healthfully warm and cozy in coldest winter weather

Oliver gives much or little heat—steady and even, for baking, broiling, frying or boiling — all at the turn of a valve. Better, cheaper, quicker.

BURNS 95% AIR—5% OIL

The Oliver Furnace Burner puts a roaring fire in hot water, steam or hot air plants. You turn it up or down, on or off by simply turning valve.



3 Times the Heat of Coal

by simply turning valve

Here is the amazing new kind of heat that has ended forever the days of woman's slavery to household drudgery. Why should any woman give her best strength and energy in endless back-breaking servitude to a hot, mussy heater, cook stove or furnace? Why should anyone worry about coal shortages and high prices? No need for that now. The wonderful invention of Mr. B. M. Oliver, of St. Louis, in one minute turns any coal or wood burner into a modern, up-to-date gas stove. It gives as much or little heat as wanted by simply turning a valve.

Cheaper than coal or wood

Mr. Oliver calls his invention the Oliver Oil-Gas Burner, because it uses 95% air and only 5% coal oil (ordinary kerosene, the cheapest fuel there is) turning them into an actual gas that burns with an intensely hot, clean flame. No wicks, no smoke, no odor.

Fits all stoves—any kind or size

Mr. Oliver's wonderful invention is made in sixteen different models to fit any kind of cook stove, heating stove or furnace. No holes to drill, no bolts to fasten, no change whatever in your stove. Simply sets in the firebox. Easily slipped in, in one minute. Absolutely safe. It lasts a lifetime.

Oliver protects your home

You can absolutely depend upon your Oliver to heat your rooms in coldest Winter weather—it gives three times the heat of coal or wood. Physicians recommend it as the surest safeguard against chill, colds, pneumonia, influenza and other sickness. The even, steady, odorless and dustless heat protects your health. It saves its cost in cleaning bills alone. Every Fall we have a coal shortage which sends prices up sky-high. But you need not worry. Install this amazing new kind of heat and you can snap your fingers at coal shortages, poor quality or high prices. Your Oliver burns the cheapest and most reliable fuel there is, kerosene.

No wonder housewives are clamoring for this wonderful device. No wonder we receive letters like these. Mrs. W. N. Spencer, of Connecticut, writes: "The Oliver in my heating stove works like magic. It is wonderful to have quick heat and no work." Mr. Elijah McClease, of Virginia, says: "It works fine. All my friends want one. I will get their orders." A letter from Mr. S. K. Pedro, of South Carolina, says: "Beats all other burners seen in this county. A sensation." Mr. Geo. Flynn, of Michigan, writes: "It is cleaner, cheaper, hotter and steadier than coal or wood. Only cost me $5.00 for two months."

Special Low Introductory Price

Now, once and for all, do away with household dirt and drudgery. End ashes, dirt, smoke, odor, chopping, shoveling, carrying dirty, heavy coal and wood. The Oliver in your stove, heater or furnace saves hours of work. Send immediately for the free attractive Booklet, "New Kind of Heat," telling all about this amazing new invention. Shows exactly how it works, how it is different from all other burners, how it will relieve you of the back-breaking work of coal and wood fires. And if you send immediately you will be in time to get a Special Low Introductory Price Mr. Oliver is now making to the readers of this magazine. Even if you do not buy now you should not miss the opportunity to become entitled to this low price should you wish to buy later, by writing at once.

Mail Coupon for Free Offer

Don't send a cent. You can get this interesting Free Book and full information, without obligation. But don't delay. To get this big special offer you must act quick. Fill in and mail the coupon now.

OLIVER OIL-GAS BURNER

OLIVER OIL-GAS BURNER COMPANY

Oldest and largest manufacturers of oil gas burners in the world

2007-J Oliver Building St. Louis, Mo.

Canadian Distributors, 2007-J Oliver Bldg., Toronto, Ont.

OLIVER OIL-GAS BURNER Co., 2007-J Oliver Bldg., St. Louis, Mo.

Without obligation send me your FREE book "New Kind of Heat" and Special Low Price Introductory Offer. I am interested in the burner for a

☐ Coal Range ☐ Heating Stove ☐ ..... Furnace (Specify steam, hot air or hot water)

Name.....

Address.....

City..... State.....

I need more Salesmen Agents and Distributors

Here is your opportunity to "cash in" on this Nation-wide sweep of oil. Housewives everywhere are clamoring for this amazing new Burner. Oliver agents are making fortunes.

F. W. Bentley, of Phila., says, "Ye gods, some seller! I made $215 today." J. Carnegie, So. Dakota, writes, "Making $1000 a month." A. M. Russell, Conn., "Averaged $660 for last six months." R. Berger made $258 per week. Mrs. Selder, Kans., made $100 a month, spare time only in her own home.

I want men and women of every type. If you want to earn $40 to $50 a week in spare time, write me. If you can give all your time as a salesman and want $200 to $250 a week, write me. If you can swing a whole territory and want $5,000 to $15,000 a year, wire me at my expense for sales plan and how you can get an exclusive franchise for your territory. But act at once if you want to "cash in" on this great new fuel idea.

Write today for sales plan and free book "New Kind of Heat". Address me personally, B. M. Oliver, President, at address shown above.

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